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PROCEEDINGS

OF THE

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

VOLUME X.—1883-84.

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WILKINSON, J. P.	Surveyor to the Local Board, Newton Heath, near Manchester.
WILLCOX, J. E.	Surveyor to the Aston Rural Sanitary Authority.
WILSON, J. B.	Surveyor to the Local Board, Arlecdon and Frizington, Cumberland.
WILSON, J. P.	Town Hall, Bury.
WILSON, J.	Surveyor to the Local Board, Bacup, Lancashire.
WILSON, WILLIAM	Surveyor to the District Local Board, Dalton-in-Furness.
WINSHIP, G., Assoc. M.I.C.E.	Borough Surveyor, Abingdon, Berks.
WITTS, J. W.	Surveyor to the Local Board, Wavertree.
WOOD, A. R.	Surveyor to the Local Board, Tunstall.
WORSWICK, R. A.	Surveyor to the Local Board, Whitley, Newcastle-on-Tyne.
WRIGHT, J.	Borough Surveyor, Macclesfield, Cheshire.

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TOWNS AND DISTRICTS REPRESENTED BY MEMBERS OF THE ASSOCIATION.

Abingdon	G. Winship.
Accrington	E. Knowles.
Aldershot	W. L. Coulson.
Alton	J. Barlow.
Arlecdon	J. B. Wilson.
Ashton-under-Lyne	J. T. Earnshaw.
Aston Manor	W. A. Davies.
„	J. E. Willcox.
Audenshaw	J. H. Burton.
Bacup	J. Wilson.
Barking	C. J. Dawson.
Barnsley	J. H. Taylor.
Barrow-in-Furness	W. H. Fox.
Barton-upon-Irwell	C. C. Hooley.
Barton, Eccles, Winton, and Monton	T. Heywood.
Batley	J. W. Horsfield.
Beckenham	G. B. Carlton.
Bedford	J. Lund.
Benwell	T. Dawson.
Beverley	J. Beaumont.
Bingley	R. Armistead.
Birkenhead	T. C. Thorburn.
Birmingham	W. S. Till.
„	E. Pritchard.
Blackburn	J. B. McCallum.
Blackpool	T. Sunderland.
Blaydon-on-Tyne	M. Hawdon.
Bognor	W. L. Barrett.
Bolton	J. Proctor.
Boston	W. H. Wheeler.
Bournemouth	G. R. Andrews.
Bowdon	J. Newton.
Bradford	J. H. Cox.
Brecknock	R. Davies.
Bridgewater	G. B. Laffan.
Bridlington	S. Dyer.
Brighton	P. C. Lockwood.
Bristol	F. Ashmead.
Briton Ferry	H. F. Clarke.
Bromley	H. S. Cregeen.
Burnley	J. E. Stafford.
Burton-upon-Trent	E. Clavey.
Bury	J. Cartwright.
„	J. Farrar.
„	J. P. Wilson.
Buxton	J. Hague.
Canterbury	J. G. Hall.
Carlisle	H. U. McKie.
Cheltenham	G. W. Sadler.
Chester	I. M. Jones.
Chesterfield	W F. Howard.
Clevedon, Somerset	H. Taylor.
Coventry	E. J. Purnell.
Crewe	G. Eaton.
Croydon	T. Walker.

Dalton-in-Furness	William Wilson.
Derby	Thos. Coulthurst.
Dewsbury	R. J. Duff.
,,	B. C. Cross.
Dorchester	W. Thomas.
Dorking	G. S. Mathews.
Dover	M. Curry.
Dukinfield	H. Veevers.
Ealing	C. Jones.
Eastbourne	C. Tomes.
Edmonton	F. J. Ricketts.
Epsom	J. R. Harding.
Exeter	C. E. Ware.
Fenton	S. A. Goodall.
Gateshead-on-Tyne	J. Bower.
Gloucester	R. Read.
Goole, Yorkshire	E. C. B. Tudor.
Grantham, Lincolnshire	S. G. Gamble.
Great Grimsby	J. Maughan.
Great Yarmouth	J. W. Cockrill.
Halifax	E. R. S. Escott.
Hanley	J. Lobley.
Harborne	W. Newey.
Harwich	H. Ditcham.
Heckmondwike	T. Gledhill.
Hendon	J. Pollard.
Hereford	J. Parker.
Heston and Isleworth	W. B. Bromley.
Hexham	R. Grieves.
Heywood	J. Diggle.
Hornsey	T. De C. Meade.
Hove	E. B. Ellice-Clark.
Hull	J. Fox Sharp.
Hurst Brook	J. Heys.
Hyde	J. Mitchell.
Ilfracombe	Philip Pile.
Ipswich	E. Buckham.
Jarrow	J. Petree.
Kidderminster	A. Comber.
King's Lynn	E. G. Mawbey.
King's Norton	R. Godfrey.
Kirkleatham	J. Howcroft.
Lancaster	A. Creer.
Leeds	T. Hewson.
Leek	T. Frost.
Leicester	J. Gordon.
Leigh, Lancashire	G. Dickenson.
Lewes	A. Holt.
Leyton, E.	W. Dawson.
Lincoln	R. A. MacBrair.
Littleborough	F. H. Shuttleworth.
Liverpool	C. Dunscombe.
,,	G. F. Deacon.
,,	J. H. Smethurst.
,,	G. Biddle.

Llandudno	T. T. Marks.
Loftus, Saltburn-by-the-Sea	T. W. Stainthorpe.
Longton	A. Hardwicke.
Loughborough	F. Baker.
Lowestoft	R. H. Inch.
Luton, Bedfordshire	W. H. Leete.
Macclesfield	J. Wright.
"	H. S. Aspinwall.
Maidstone	F. J. C. May.
Malton	J. L. Webster.
Manchester	J. Allison.
"	S. C. Trapp.
"	R. Vawser.
Matlock	J. Bourne.
Merthyr Tydfil	S. Harpur.
Middlesbrough	E. D. Latham.
Middleton (Lancashire)	W. Welburn.
Milverton	G. F. Smith.
Morpeth	T. W. Middlemiss.
Neath	W. Whittington.
Nelson-in-Marsden	W. Dent.
Newark	Geo. Sheppard.
Newcastle-on-Tyne	W. G. Laws.
"	J. P. Spencer.
Newcastle-under-Lyme	J. Pattison, jun.
Newton Heath	J. P. Wilkinson.
Newton-in-Makerfield	R. Brierley.
Northampton	J. H. Pidcock.
North Bierley	J. Cook.
Nottingham	A. Brown.
Oldbury	J. Devis.
Oswestry	E. B. Smith.
Over Darwen	W. Stubbs.
Oxford	W. H. White.
Plymouth	R. Hodge.
Portsmouth	H. P. Boulnois.
Prescot	W. Goldsworth.
Ramsgate	W. C. Barley.
Reading	A. W. Parry.
Redditch	T. W. Baylis.
Reigate	J. H. C. B. Hornibrook.
Rhyl	Robt. Hughes.
Richmond	F. S. Brunton.
Rochdale	S. S. Platt.
Rochester	W. Banks.
Rotherham	G. Jennings.
Rugby	W. Stewart.
Ryde	F. Newman.
Sale	A. G. McBeath.
Sevenoaks	J. Mann.
Sheerness	H. W. Stringfellow.
Sheffield	R. Davidson.
Shrewsbury	G. J. Butler.
Skipton	A. Ramsden.
Southampton	J. Lemon.
Southgate	C. G. Lawson.
Southport	W. Crabtree.
Southport	J. Hart.

South Shields	M. Hall.
South Stockton	S. E. Thorrold.
Sowerby Bridge	H. Whitlow.
Stafford	W. Blackshaw.
Stamford	Jas. Richardson.
Stockport	A. M. Fowler.
Stockton-on-Tees	J. Hall.
Stoke-on-Trent	W. Bowen.
Stratford-on-Avon	A. T. Davis.
„ „	T. T. Allen.
Stretford	H. Royle.
Stroud	J. P. Lofthouse.
St. Thomas, near Exeter	S. Churchward.
Sunderland	R. S. Rounthwaite.
Swansea	E. Cousins.
Swinton, near Rotherham	J. C. Haller.
Teddington	T. Goodchild.
Tewkesbury, Gloucestershire ..	W. H. Gray.
Tipton	S. F. Rowley.
Tiverton, Devon	Wm. Rowe.
Todmorden	A. Greenwood.
Tonbridge	W. Noot.
Torquay	Joseph Hall.
Toxteth Park	J. Price.
Tranmere	W. A. Richardson.
Tunstall	A. R. Wood.
Tynemouth	C. T. Gomoszynski.
Ventnor	R. S. Scott.
„	J. G. Livesay.
Wakefield	R. Porter.
Wallasey	J. T. Lea.
Walthamstow	G. B. Jerram.
Wanstead	J. T. Bressey.
Warminster	T. Cruse.
Warwick	E. M. Richards.
Waterloo, Liverpool	R. Thompson.
Watford	C. C. Lovejoy.
Wavertree	J. W. Witts.
Wellingborough	E. Sharman.
West Bromwich, Staffordshire ..	J. T. Eayrs.
West Derby, Liverpool	E. H. Allies.
West Ham, London	L. Angell.
West Hartlepool	J. W. Brown.
„	G. Scott.
Weymouth and Melcombe Regis ..	W. B. Morgan.
Whitehaven	R. Pickering.
Whitley	R. A. Worswick.
Whitworth	Thos. Holt.
Willesden	O. C. Robson.
Willington Quay, Northumberland	P. W. Thomson.
Wimbledon	W. Santo Crimp.
Windsor	T. V. H. Davison.
Wirksworth	J. Simpson, junr.
Withington	J. Swarbrick.
Wolverhampton	G. E. Thoms.
Woodford	J. D. Hooper.
Worksop	J. Allsopp.
Wrexham	J. W. M. Smith.
„	A. S. Jones.
York	W. G. Penty.

UNIVERSITY OF ILLINOIS LIBRARY

RULES OF THE ASSOCIATION.

I.—That the Society be named the "ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS."

II.—That the objects of the Association be—

a. The promotion and interchange among its Members of that species of knowledge and practice which falls within the department of an Engineer or Surveyor engaged in the discharge of the duties imposed by the Public Health, Local Government, and other Sanitary Acts.

b. The promotion of the professional interests of the Members.

c. The general promotion of the objects of Sanitary Science.

III.—That the Association consist of Civil Engineers and Surveyors holding chief permanent appointments under the various Municipal Corporations or Sanitary Authorities within the control of the Local Government Board, and such Honorary Members as shall be elected by the Council. Members who cease to hold such appointments after the Annual Meeting of the Association in 1881 are eligible for re-election by the Council, but will be disqualified from holding any office. That Civil Engineers and Surveyors holding such appointments in Scotland or Ireland, in the Colonies or Foreign Countries, shall be eligible for election as Members, subject to the approval of the Council.

IV.—That the Affairs of the Association be governed by a Council, consisting of a President, Three Vice-Presidents, Twelve Members, and an Honorary Secretary, to be elected annually. The Past Presidents and the District Secretaries for the time being shall also be Members of the Council.

V.—That the Council shall nominate one name for President, six for Vice-Presidents, one for Hon. Secretary, and forty Ordinary Members from which to elect the Council. Such Nominations shall be printed and sent to each Member of the Association not less than fourteen days previous to the Annual Meeting. Every Member shall be entitled to vote for or erase any of such Nominations, or substitute other names, subject in all cases to the limits of Rule IV., and return the same within seven

days from the date of issue. Such ballot papers shall be examined in London by the President, Secretaries and two Scrutineers appointed at the previous Annual Meeting, or by any two of the aforesaid Members.

VI.—That the Association be formed into District Committees which shall include the whole of the Members. Such Committees shall meet from time to time, in convenient centres, for the discussion of matters of local and general interest connected with the Association. Each District Committee shall appoint a District Secretary, who will keep records of local proceedings, and communicate with the Council. All District Secretaries shall vacate their office at the Annual Meeting, and Members shall then be appointed to act as Local Secretaries until a District Meeting can be arranged, at which Meeting a District Secretary shall be appointed.

VII.—That a General Meeting and Conference of the Association shall be held annually in such towns, in rotation, as may afford convenient centres for assembling the Members.

VIII.—That an entrance-fee of One Guinea, and a subscription of One Guinea per annum, from Civil Engineers and Surveyors under Rule III., shall constitute Membership of the Association.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

ELEVENTH ANNUAL MEETING.

NEWCASTLE-ON-TYNE, *July* 10*th*, 11*th*, *and* 12*th*, 1884.

GENERAL BUSINESS.

THE Members assembled in the Council Chamber of the Town Hall, Newcastle-on-Tyne, when Mr. W. H. White, President, took the chair.

The Mayor of Newcastle (Dr. W. H. Newton), accompanied by Ald. Wilson, Chairman of the Town Improvement and Sanitary Committee, Ald. Barkas, Councillor Youll, and the Town Clerk, attended and welcomed the Association to Newcastle—the Mayor on behalf of the Council, and Ald. Wilson on the part of the Sanitary Committee.

The Minutes of the Annual Meeting held in Oxford in June 1883 were then read, confirmed, and signed.

The SECRETARY then read the Annual Report for the year ending April 30th, 1884.

ANNUAL REPORT.

The Council in presenting their Annual Report have much pleasure in being able again to congratulate the Members upon the continued success and steadily maintained progress of the Association during the past year.

The following District Meetings have been held since the last General Meeting, which was held at Oxford, on the 30th June, 1883, and the two following days: at Bury, on the 8th of September; at Carlisle, on the 28th of September; at South Shields, on the 16th February of the present year; at Brighton, on the 15th March; at Leicester, on the 10th May; and at

Ealing, on the 24th May. The eminent success that has attended these Meetings has been warmly appreciated, a fact evinced not only by the large numbers attending, but by the well-sustained discussions on the valuable papers which were read, and the opportunities of visiting works in the respective neighbourhoods, affording information of a most useful and instructive character.

In addition to these ordinary District Meetings, supplementary meetings have been held at the Manchester Corporation Waterworks, and at Liverpool, where the works of the Mersey Tunnel were inspected, likewise the landing stages, the tramways, and special paving works of the Corporation of Liverpool.

The Council has to announce that fourteen new Members have joined the Association during the past year; five Members have resigned; four have been written off, the letters addressed to them having been returned; while regretting having to report three deaths, J. A. Hall, of Toxteth Park; J. Holmes, of Selby; and R. Salisbury, of Burnham. The number on the roll of the Association at the close of the year was 5 Honorary Members, 212 Ordinary Members, making 217 in all; and the Council again request that every Member will endeavour to increase this total by inducing their brother officers who have not already joined to become Members, and so increase the strength and efficiency of the Association.

In accordance with the Rules of the Association, the ballot lists were issued, with the result that the following gentlemen have been elected to the Council:—

President.—W. G. Laws.

Vice-Presidents.—J. Gordon, J. Lobley, and R. Vawser.

Ordinary Members of Council.—J. Allison, H. P. Boulnois, J. Cartwright, R. Davidson, Chas. Dunscombe, E. B. Ellice-Clark, T. Hewson, I. M. Jones, P. C. Lockwood, H. U. McKie, A. W. Parry, and T. Walker.

General Honorary Secretary.—C. Jones.

Treasurer.—L. Angell.

The satisfactory state of the Association is borne out by the accompanying duly audited Balance Sheet of the financial year, showing a balance in hand of 119*l.* 3*s.* 10*d.* The sound financial position of the Society is shown by the statement of assets and liabilities.

The Council have been alive to the necessity of watching the progress of and discussing the various Bills introduced into

Parliament, having a bearing upon those matters with which their Members as a body have to do, such as Sir John Kennaway's Bill, "The Inspection of Houses Bill," &c., and attention having been drawn to the necessity of certain amendments to the Public Health Act, your Council have carefully considered the matter, and having appointed of their number Messrs. Angell and Jones, those gentlemen have drafted a memorial on this important subject which will be duly forwarded to the President of the Local Government Board. This memorial will be followed by a deputation to further the object sought by the Council in this important subject.

The Council has considered the advisability of widening the Bye-Laws of the Association to admit surveyors holding chief municipal appointments in Scotland and Ireland, in the Colonies, or Foreign Countries—an addition to the existing rule governing admissions will be submitted to you to enable this to be done.

The next Annual Meeting will be held in London, in conformity with the custom that has heretofore prevailed.

The PRESIDENT moved and Mr. LAWS seconded the adoption of the Report.

Mr. JERRAM moved the following amendment to the clause of the Report referring to the memorial to the Local Government Board:—

"That the proposed memorial to the Local Government Board by the Council concerning the amendments of the Public Health and Sanitary Acts be not submitted, until it has been presented to and approved by the Members of the Association in such manner as the Council shall determine."

This was seconded by Mr. VAWSER, and after some discussion it was adopted, with the understanding that the Council should take what course was thought best to elicit the views of the Members of the Association.

Mr. JERRAM then objected that only thirty-nine names of ordinary Members were submitted at the last election of officers and Council, as the list included the name of a District Secretary, who was ex-officio a Member of the Council, and consequently the rule had not been carried out. He protested against this part of the Report.

The PRESIDENT ruled that Mr. Vawser was on the occasion in question an Ordinary Member of the Association, and

The Report of the Council was then passed and the ballot papers ordered to be destroyed.

Mr. Gamble, of Grantham, and Mr. A. W. Parry, Reading, were elected auditors for the ensuing year.

Mr. G. B. Carlton (Beckenham), Mr. De Courcy Meade (Hornsey), Mr. W. Dawson (Leyton), and Mr. A. Holt (Lewes), were then appointed scrutineers for the ensuing year.

The following addition to Rule III. was proposed by the Council and passed:—

"That Civil Engineers and Surveyors holding such appointments in Scotland or Ireland, in the Colonies or Foreign Countries, shall be eligible for election as Members, subject to the approval of the Council."

Mr. Vawser proposed and Mr. Jerram seconded that the last two sentences of Rule VI. shall read as follows:—

"Each District Committee shall appoint a District Secretary, who will keep records of local proceedings and communicate with the Council. All District Secretaries shall vacate their office at the Annual Meeting, and Members shall then be appointed to act as Local Secretaries until a District Meeting can be arranged, at which Meeting a District Secretary shall be appointed."

It was decided that this should be acted upon at once in the cases of the Yorkshire, Western, and Eastern Counties districts, which latter it was agreed should be revived, and the following gentlemen were accordingly appointed to act as Hon. Secretaries to the respective Districts:—

Mr. O. C. Robson, Willesden	*Home Counties District.*
Mr. E. Buckham, Ipswich	*Eastern* „ „
Mr. E. Pritchard, Birmingham . .	*Midland* „ „
Mr. Jos. Hall, Torquay	*Western* „ „
Mr. J. W. Horsfield, Batley	*Yorkshire* „
Mr. R. Vawser, Manchester	*Lancashire and Cheshire* „
Mr. P. W. Thomson, Willington Quay	*Northern Counties* „

Mr. De Courcy Meade moved a proposition to reduce the nominations for the Council from forty to twenty-two.

Mr. Jerram had also a motion for increasing the number of the Council from twelve to twenty, and a second motion for altering the mode of nominating candidates.

These propositions having been withdrawn, it was unanimously resolved on the motion of Mr. Laws seconded by Mr. Rounthwaite:—

"That the Council be requested to undertake the preparation of a revised code of Rules and Bye-Laws, and for this purpose to hold

a Special Meeting during the present year: that three Members be chosen by this Meeting to assist the Council in this revision, so that all opinions may be represented, viz. Messrs. Jerram, F. Newman, and T. De Courcy Meade. That the revised code be printed and circulated amongst the Members, and submitted to the next Annual General Meeting for discussion and confirmation."

Mr. WHITE, after speaking of the gratification it had afforded him to fill the post of President, said it was a great pleasure to him to be succeeded by a man of Mr. Laws' calibre. The Association had done itself great honour by electing Mr. Laws to the Presidential chair, and whilst maintaining its dignity he was sure that he would also advance the interests of the Association. He could not vacate the chair without expressing his thanks to the Council for their hearty co-operation, and to the Secretary for the assistance he had always readily rendered. He had very great pleasure in introducing to the meeting the new President, Mr. Laws, of Newcastle.

Mr. White then vacated the chair.

Mr. W. G. LAWS, of Newcastle, having taken the Presidential chair, briefly acknowledged the honour conferred upon him.

Mr. JONES proposed a vote of thanks to the retiring President, complimenting Mr. White on the efficient way in which he had discharged all his duties, and on the kind manner and genial disposition he had ever evinced. The Association never had a more successful year, the meetings had never been better attended, whilst never had greater cordiality prevailed.

Mr. GORDON seconded the proposition, and said the great value of Mr. White's services would be best appreciated by those who had attended the successful district meetings during the past year. The past year had been one of progress, due partly to the exertions of Local Secretaries, but also in a great measure to the energy Mr. White had evinced, and the interest he had displayed in all the proceedings of the Association. The proposition was carried with acclamation.

The PRESIDENT then read his inaugural address.*

CHAS. JONES, *Hon. Sec.*
THOMAS COLE, *Secretary.*

* This Address, and the papers read at the Meeting, will be found at the end of the volume.

Dr. STATEMENT OF RECEIPTS AND EXPENDITURE FOR THE YEAR ENDING APRIL 30TH, 1884. Cr.

RECEIPTS.	£	s.	d.
To Balance at Bank (May 1st, 1883)	126	18	4
„ Petty Cash in hand „ „	2	4	2
„ Entrance Fees	13	13	0
„ Subscriptions	180	12	0
„ Arrears	8	8	0
„ Subscriptions paid in advance	4	4	0
„ Publisher's Sale of Proceedings	17	3	5
„ Balance of Petty Cash due to Secretary	1	14	11
	£354	17	10

EXPENDITURE.	£	s.	d.
By Rochdale Meeting	3	10	0
„ Annual „ at Oxford	18	9	2
„ Middlesborough Meeting	2	15	0
„ Bury and Supplemental Meetings	6	14	2
„ Hove Meeting	8	17	6
„ Messrs. Clowes (Printing vol. ix.)	83	16	0
„ Messrs. Cook and Hammond (Printing, &c.)	15	11	1
„ Secretary's Salary	75	0	0
„ Petty Cash—Stationery, &c.	3	6	7
Postages, vol. ix.	3	19	7
„ General	4	10	8
„ Circulars	4	14	9
Photo-lithos, Mr. White's Paper	2	7	6
„ J. Swain— „ „ Mr. Pritchard	2	2	0
„ Balance at Bank, 30th April, 1884	119	3	10
	£354	17	10

STATEMENT OF ASSETS AND LIABILITIES, APRIL 30TH, 1884.

LIABILITIES.	£	s.	d.
To Estimated Liability on vol. x.	30	0	0
„ Sundry Printing	5	0	0
„ Outstanding Accounts	0	0	0
„ Balance, Petty Cash due to Secretary	1	14	11
„ Balance	150	16	2
	£187	11	1

ASSETS.	£	s.	d.	£	s.	d.
By Balance at Bank				119	3	10
„ Subscriptions in Arrear	£64	1	0			
„ „ less 50 per cent. bad	32	0	6	32	0	6
„ Proceedings in Stock	£72	13	6			
„ „ less 50 per cent.	36	6	9	36	6	9
				£187	11	1

Examined and found correct, ALBERT W. PARRY, WILLIAM DAWSON, } *Auditors.*

LEWIS ANGELL, *Treasurer.*
CHAS. JONES, *Hon. Secretary.*
THOMAS COLE, *Secretary.*

DISTRICT MEETING AT BURY.

September 8th, 1883.

Held in the Corporation Offices, Bury.

Mr. W. H. White, *President, in the Chair.*

BURY AND ITS PUBLIC WORKS.

By J. CARTWRIGHT, Assoc. M. Inst. C.E.,

Borough Surveyor, Bury.

The following description of the principal works carried out by the Corporation of Bury is offered to the Association, not as presenting anything novel to the municipal engineer, but simply in answer to the request of the District Secretary coupled with a desire to furnish the author's humble quota of information to the general stock.

The author is aware that in inviting the members here to-day to inspect the public works of this borough he is laying himself open to their criticism, but knows that this criticism will be fair criticism, and not mere fault finding.

Bury cannot, like some of the towns the Members have visited, boast of many antiquities, but that it existed as a town in early Saxon times there is little doubt, having its feudal castle within a few yards of this spot. The Romans too have left distinct traces in the district of the great road from Manchester to Ribchester, supposed to have been constructed about A.D. 79.

The industry of the people (though not so progressive as some towns of later birth) has continued, ever since the days of the reign of Edward III., when the Flemings established themselves in the town as cloth-weavers, and the town now possesses probably a greater variety of trades than any other town in the manufacturing districts of Lancashire. Amongst the principal are woollen, bleaching, paper-making, cotton, machine making, hat manufacturing, &c.

Previous to the year 1846 Bury, strictly speaking, had no form of local government, save and except that provided by the parish vestry. In that year, however, an Act of Parliament was obtained

establishing a local authority, to be called the "Bury Improvement Commissioners"; this Act of Parliament gave the Commissioners large powers over the lighting, paving, and scavenging of streets and courts. The Commissioners worked under this Act and the Acts incorporated therewith until the year 1872, when an Improvement Act was obtained giving them power, in addition to other matters, to acquire the undertaking of the water company who supplied the town with water, the markets and manorial rights and other matters, and to extend the boundary of the borough to portions of the outlying districts.

In the year 1876 a Charter of Incorporation was obtained and the town divided into five wards, governed by a mayor, ten aldermen, and thirty councillors.

The town is 198 miles N.N.W. of London, and is situated on the banks of the rivers Roach and Irwell, which surround the borough on the easterly, westerly, and southerly sides.

The drainage area is nearly equally divided to each river, the Roach forming a confluence with the Irwell at the southerly extremity of the borough.

The Municipal Borough comprises an area of 3389 acres, and includes the whole of the townships of Bury, with portions of Elton, Radcliffe, Walmersley-cum-Shuttleworth, Birtle, Heap, Pilsworth, and Tottington lower end.

The number of houses is 10,732. The population (last census) 52,000, and the rateable value 226,000*l*. There are 36 miles of paved streets and 12¾ miles of streets laid out but not paved, and 1700 street lamps.

Waterworks.

The Waterworks Company was first established under an Act of Parliament obtained in 1838, the main source of supply up to 1846 was a small impounding reservoir 3¾ acres in extent, with a gathering ground of 170 acres, having a capacity of 5½ million cubic feet, at an altitude of 660 feet above sea-level, situate in Shuttleworth, about 4 miles to the north of the town of Bury, and a small service of 3¾ acres at Spout House 375 feet above sea-level, about one mile to the north of the town, and having a capacity of 1½ million cubic feet.

Shortly after the passing of the Bury Improvement Act in 1846, the demand for water increased to such an extent, that the Company were obliged to apply to Parliament for powers to construct the Gin Hall Reservoir, 14 acres in extent, about 2¼ miles to

the north of Bury, 475 feet above sea-level, with a capacity of 7 million cubic feet, and a gathering ground of 160 acres. The Company also took power to construct a conduit through Baldingstone, to avail themselves of the water flowing down the Longcroft Brook a little to the south of the reservoir; but owing to the enormous claims for compensation made by the mill-owners using the stream, this part of the undertaking was abandoned, and consequently the water supply again fell short and the Company were compelled to apply to Parliament in 1853 for a Bill to construct a reservoir at Calf Hey, about 8 miles to the north-west of Bury and about 2½ miles to the west of the town of Haslingden, but owing to the opposition of a rival company formed to supply other portions of the Irwell Valley, the Bury Waterworks Company was transformed into the Bury and Radcliffe Waterworks Company, having a district of about 20 miles in length by an average of 4 miles in width down the Irwell watershed and embracing some twenty different townships and hamlets.

The Calf Hey Reservoir, constructed after the passing of the 1853 Act, is 800 feet above sea-level, has a gathering ground of 872 acres, a surface area of 23 acres and a capacity of 22 million cubic feet. The first conduit from this reservoir and the only one in use until some three or four years ago, was laid with earthenware pipes to a small service reservoir at Holden Wood, about 1 mile below the impounding reservoir: this earthenware conduit is now superseded by an 18-inch iron main, which is continued to the Gin Hall Reservoir, now mainly used as a service reservoir.

Soon after the completion of the Calf Hey Reservoir, the Company acquired the Holden Wood Reservoir, which had been constructed some years previously on the same stream to supply the mills down to its junction with the river Irwell. This reservoir has a gathering ground of 349 acres, a surface area of 20 acres, at an elevation of 670 feet above sea-level, and a capacity of 14 million cubic feet, and is now used as a compensation reservoir, the Waterworks Committee being under obligations to supply 6 cubic feet of water per second to the mill-owners on the stream, which, in dry seasons, is a heavy tax.

In 1872 the then Bury Improvement Commissioners having agreed to purchase the Bury and Radcliffe Waterworks, and as, owing to the increasing wants of the district, further extensions became necessary (in several dry seasons the water supply having become very inadequate), the Bury Improvement Act, 1872—mainly a waterworks bill—was resolved upon, and concurrently with

the passing of this Act, the Commissioners completed negociations for purchasing the undertaking of the Haslingden and Rawtenstall Waterworks Company, who had under the powers of an Act passed in 1853, constructed a reservoir at Hapton, about 3 miles south of Burnley, and 11 miles north of Bury, at an altitude of 925 feet above sea-level, with a gathering ground of 1300 acres, a surface area of 88 acres, and a capacity of 56 million cubic feet.

This reservoir, though only intended in the first instance to supply the wants of the towns of Haslingden and Rawtenstall with a few outlying villages, is capable of supplying a much larger area, and the purchase of it rendered the immediate carrying out of one of the main provisions of the 1872 Act, viz. the construction of the Ogden Reservoir in the Haslingden Valley, unnecessary. This latter reservoir, for which all the land and water rights necessary have been acquired, will have a gathering ground of 964 acres, a surface area of 53 acres, at an altitude of 730 feet above sea-level, with a capacity of 56 million cubic feet.

By the 1872 Act, the power to construct the Clarke's Hill Service Reservoir in Pilkington, about 3½ miles from Bury, was obtained. This reservoir is designed to supply the wants of the high lying portions of the district to the south of the town, and is also capable, should an accident occur to the mains above Bury, of supplying the borough itself for a short time.

The reservoir is of a rectangular form, constructed on the crest of a hill at an altitude of 443 feet above the sea-level, having retaining walls and banks on three sides, of a mean height of 35 feet above the old formation; it has a surface area of 2 acres and a capacity of 7¾ million cubic feet, and was completed about five years ago at a cost of 21,200*l.*

Contingent on the works authorised by the 1872 Act, there has been expended during the last five years in the laying of new mains to the Clarke's Hill Reservoir, and in other alterations in the system of supply from the various reservoirs a sum of 40,200*l.* The purchase of land and water rights for the intended Ogden Reservoir, acquired by private agreement and by arbitration, has required an outlay of 27,000*l.* There has also been expended within the last three years a sum of 3060*l.* in the renewal of various works at Calf Hey Reservoir, comprising the removal of silt from the various inlets, the renewal of clows, fencing, &c., and the construction of a new flood-water channel.

The Waterworks Committee have at the present time under con-

sideration a scheme for the construction of a small high service reservoir at Haslingden at about 1000 feet elevation, to supply houses erected above the level of the highest reservoir. It is proposed to supply this reservoir from a pumping station to be erected in the Ogden Valley near the lower end of the Holden Wood Reservoir, on land already in the possession of the Corporation, the water being supplied from the new Ogden Reservoir. The proposed site of pumping station is at an elevation of some 680 feet above O.D., the lift to the proposed reservoir being thus 320 feet, the rising main having a length of about $1\frac{1}{4}$ mile. The land and wayleave for this reservoir have been acquired for the sum of 1670*l.*, and the construction of reservoir, pumping station, rising main, &c., is estimated to cost 8000*l.*

The total expenditure on capital account up to March 1872 has been 367,561*l.* 8*s.* 8*d.*; the revenue for the year ending March 31, 1883, was 25,281*l.* 1*s.*, and the expenditure about 27,800*l.*, showing a loss for the year of some 2500*l.*

The total storage capacity of the various reservoirs, including the "Ogden," is $169\frac{3}{4}$ million cubic feet, having a surface area of $207\frac{1}{2}$ acres, and a total gathering area of 3815 acres. The district of supply embraces an area of 80 square miles, and the number of houses at present supplied is 26,107, having a population of about 130,000.

Markets.

The Market Hall was erected in 1839 by the lord of the manor, the Earl of Derby, but up to the year 1868 the only parts of the market roofed were three ranges of shops forming the sides of the triangular inclosure. In the year 1868 this open space was covered in, and in this form was handed over to the Bury Improvement Commissioners under the powers of their Act of 1872, by which they obtained, under agreement with Lord Derby, the Market Hall, such of the manorial rights as regarded the levying of tolls, together with a plot of vacant land adjoining the market on which to hold the fairs. On a portion of this land there have been erected fish market, piggeries, and slaughter-houses. The cost of the Market Hall and manorial rights was 26,500*l.*, the cost of the 12,560 square yards of vacant land, 24,750*l.*; the Market Committee have spent on permanent improvements to the Market Hall 344*l.*, on the erection of fish market, containing 10 stalls, 821*l.*, and on the piggery 680*l.*, a portion of which they have lately converted into a public slaughter

house at a cost of 304*l.*; the total expenditure on capital account being thus over 52,400*l.*; the annual revenue is about 2200*l.*, and the expenditure, including sinking fund, 3600*l.*, showing an annual deficiency of 1400*l.* The Market Hall covers an area of 3625 square yards, and is triangular on plan, having ornamental stone entrances at each corner. There is an outer range of 48 shops having cellars in basement, and the inclosure is occupied by 148 stalls, the whole being covered by a wrought-iron roof, the main spans being 60 feet, supported on cast-iron columns 20 feet high.

Gasworks.

The Bury Gasworks was established by a company in the year 1828 and was transferred to the local authority, the Improvement Commissioners, in the year 1858. Notwithstanding that additions had been made from time to time, in the year 1877 the Gas Committee reported to the Council that the works had become inadequate to the wants of the district, and that unless steps were taken to extend the works great loss and inconvenience must follow. The Committee further pointed out the desirability of securing a new site, if possible, in juxtaposition to the railway. Several sites were selected, but the landowners not being willing to fix upon a price for purchase by agreement, the matter of a new site fell through for the time being, and the Committee commenced the erection of condensers, scrubbers, exhauster, and gasholder on the old site.

The following is a description of these several works.

Two scrubbers 10 feet internal diameter, and 54 feet high; these are fitted with boards having ½-inch spaces, the object being to provide the largest saturated surface. The gas makes its way upwards, being met by a spray of water which is distributed by the aid of machinery; this machinery is protected by a house fixed on the top, and is approached from the ground by a zigzag staircase fixed between the two scrubbers, the total height from ground to top of house being 75 feet. The cost of the scrubbers has been more than repaid by the extra amount of ammonia extracted from the gas in its passage.

Condensers.—These are of the type known as the vertical annular. The apparatus consists of a column composed of two wrought-iron concentric plates; the gas passing between the space of the two plates, while both the inside and the outside present cooling surfaces

over which the atmosphere may freely play. The dimensions are as follows: inner diameter 20 inches, outer diameter 30 inches, leaving a space for the gas of some 5 inches; the height of columns 25 feet. There are two rows of columns, 12 in each row, the whole being fixed upon a bed of brickwork with stone coping. The foundations stand above the ground 5 feet. The total height from ground is therefore 30 feet. The apparatus is fitted with the necessary siphons to take off the tar that forms in the passage of the gas, and with valves which allow the gas to pass through both or either according to the quantity of gas made, and also to by-pass them both if necessary. The condensers are calculated to pass 70,000 cubic feet of gas per hour.

Exhauster.—This is on the direct pumping system, and is capable of passing 60,000 cubic feet per hour; great nicety being required in the working of this apparatus, so as to insure the free passage of the gas, the working parts are all neatly finished and evenly balanced.

Gasholder.—The new holder and tank is of the following dimensions: 120 feet diameter, in two lifts of 35 feet each, estimated to hold 800,000 cubic feet of gas. By the aid of this "holder" and the men working overtime at the week end, a quantity of gas was stored at the beginning of each week, by which, together with the introduction of improvements in the retort settings, the yield of gas was increased, and matters were kept going for three or four years longer. When, however, the lighting season of 1881 arrived, the demand was found to have again overtaken the make of gas, and the question of extension both of the carbonising and purifying plant forced itself once more on the attention of the Committee. To add to the perplexity the newspapers declared about this time that the electric light for public purposes was established beyond all dispute; the Gas Committee, nothing daunted, at once decided to inquire into the matter, and ascertain for themselves the truth or otherwise, before entering on a large expenditure. They visited the Electric Exhibition, then being held at the Crystal Palace, and put themselves in communication with the best exhibitors of that light. They were interested and instructed by their investigations; but their conclusions were, that though great advancement had been made in electric lighting, they could only admit the light was an experimental success, and they determined to proceed with the extension of the carbonising and purifying plant upon the present site, adopting the best known

methods of construction. Instructions were given to proceed with the building of a new retort-house, purifier and meter-houses, and these several buildings are now approaching completion. The following is a description of these works:—

Retort-house.—Inside measurement, 145 feet by 129 feet 6 inches, height of building to spring of roof 31 feet 8 inches. Concrete has been employed for all foundations below ground-level. The roof is of wrought iron, in two spans of 65 feet 9 inches, principals 8 feet 2¼ inches apart, the centre being supported by a longitudinal trellis girder 2 feet 8 inches deep, supported on four cast-iron columns 29 feet high. The covering is of Vellenheli slates, with intervals of skylights. Ventilation is provided by a raised roof on both spaces, and by the usual openings at sides, &c. The old retort-house covered an area of 11,450 feet, contained 280 mouthpieces, capable of producing 1,000,000 cubic feet of gas per diem. The new retort-house covers an area of 20,470 feet, with 312 monthpieces capable of producing 2,600,000 cubic feet of gas per diem, which is expected at the present rate of increase to provide for eleven years.

Retort Benches.—The benches with all their mountings and connections were supplied and erected by West's Gas Improvement Company, Maidstone. The dimensions of the retorts are 10 feet long, and 20 inches by 16 inches wide. The mouthpieces are all fitted with Holman's patent self-sealing lids. The Mechanical Stokers were also supplied by the West's Gas Improvement Company: they consist of drawing and charging machine, engine and coal-breaker, chain elevators, &c. The coal, after delivery by cart, is not again handled, but by the aid of machinery is passed from the storage place to the hoppers, and from there to the retorts.

Mr. Parsons, the gas manager, will be at the works at our inspection this afternoon, and will be prepared to answer any question with respect to the working of this plant, &c.

Purifier-house.—On account of the limited area, this is erected in two storeys, the purifiers being placed on the upper floor, the ground floor forming an area for spreading out the spent oxide for renovation. The inside measurement of this house is 83 feet 6 inches by 77 feet 2 inches, the height to the spring of the roof 36 feet. Concrete has been used in the whole of the foundations below the surface of the ground. The roof is of wrought iron in three spans of about 28 feet each. The principals are 8 feet

5 inches apart. The roof is boarded and slated, with large louvre ventilators, one over the centre of each purifier.

Purifiers.—These are six in number, each 30 feet by 20 feet 6 inches and 5 feet in depth. The contract for this work is in the hands of Messrs. Newton, Chambers, and Co. The connections will all be 18 inches in diameter, the centre valves are being supplied by Messrs. C. and W. Walker, of Donnington.

Meter-house and Meter.—The meter-house is of the following dimensions: 28 feet by 28 feet, and 22 feet 9 inches to spring of roof. The inside walls are in pressed brick tuck pointed, the flooring and dado in Minton tiles. The meter which is being supplied by Messrs. Braddock, of Oldham, will pass 50,000 cubic feet per hour.

The total cost of the works here described are:—

	£
Scrubbers	1620
Condensers	1700
Retort-house	6500
Retort benches	7520
Stoking machinery, &c.	2000
Purifier-house	2290
Purifiers, &c.	4500
Meter-house and meter	1000
Gasholder and tank	14000
Exhauster	600
Covered sheds, tanks, valve-house, &c., &c...	4060
	£45,790

All these works have been executed during the past six years. The capital account now stands at 137,000*l.*

Drawings of these several works are exhibited upon the screen.

Bury Bridge.

As a matter of interest to Members of an Association such as this, the author desires to bring under notice some particulars and cost of the widening of the bridge over the river Irwell, which connects Elton township with Bury, and which forms part of the programme of inspection this afternoon.

The bridge consists of three arches, the centre one being 31 feet span, and the other two 27 feet each. The height from the bed of the river to the crown of the road is 25 feet. The length of the parapet on the north side is 200 feet, and on the south side 122 feet. The height of parapet above the footway on each side is

5 feet. These parapets are relieved with eight pilasters with moulded caps, the arms of the county and of the borough being carved respectively on the north and south parapets. The bridge is nearly double its former width, adding largely to its convenience and safety. Before the widening the bridge was 38 feet wide, whereas the space from parapet to parapet is now 63 feet. The footways are each 9 feet wide, leaving a carriage-way of 45 feet. The gradient of the carriage-way has also been much improved by the raising of the roadway some 2 feet 6 inches. The area of the roadway added, when the approaches on the southerly side are completed, will be over 600 yards.

The cost of the work, including pavements, is about 5000*l*.

Tramways.

These are to form the subject of a special paper by Mr. Vawser, M.I.C.E. The author, therefore, need not describe their construction or working, but merely state that the Corporation acceded to the proposals of a company to construct lines within the borough.

The engineers to the Company are Mr. Vawser, M.I.C.E., and Mr. J. W. Newton, M.I.C.E. The Company pay no royalty for the privilege of laying the lines, but the Corporation introduced stringent clauses in the "Order" to insure full control over the streets and roads, and for the paving and keeping in repair within the tramway limits by the Company.

The lines within the borough consist of 2¼ miles of 4 feet 8½ inch gauge, and 4¼ miles of 3 feet 6 inch gauge.

The cars are worked by Wilkinson's engines, and are fitted with Grover's flexible wheel base.

Street Improvements.

Much has been done in Bury in the widening of main streets and the removal of confined courts and passages.

At the present time the Corporation are engaged in the widening, &c., of Rock Street, which by reason of its narrowness and increased traffic has rendered this improvement necessary.

The cost of acquiring this property and land for widening the street will far exceed any return the Corporation will reap in the reselling of the surplus land; but the gain will be to the health, comfort, and safety of the inhabitants. A plan of this improvement is shown upon the screen.

Public Baths.

The erection of the Bury Public Baths was commenced in 1863. The money was to have been raised by public subscription, but as only one-third of the necessary funds was realised, the building was handed over to the then Bury Improvement Commissioners, who completed the work at a cost of about 3500*l.*, the baths being opened in May 1864.

The buildings contain ten first class and ten second class slipper baths, two private baths, first and second class swimming baths, each 52 feet by 20 feet, a vapour bath and a Turkish bath, with a dwelling-house for superintendent.

In connection with the Turkish baths the hot air is supplied by one of Whittaker's convoluted stoves, the hot air first entering the top of the chamber, which, as it cools, falls to the floor, and is there extracted by tubes fixed in the walls. The baths are well frequented, and it is intended to extend them by adding another swimming bath of a greater area.

The entire site contains an area of 2500 square yards, and is subject to a chief rent of 30*l.* per annum. The total annual expenditure, exclusive of interest on outlay, averages about 520*l.*, and the revenue is about 400*l.*, there thus being an annual charge on the borough fund of about 120*l.*

Building Bye-laws.

The bye-laws in force within the borough are found to be inadequate for properly regulating the laying out and construction of new streets and buildings, and much labour, thought, and attention have been bestowed upon the formulating of a new code, to meet the requirements of the borough. These, when submitted to the Local Government Board, however, obtained the fate of all other attempts of this kind, viz. they were relegated back to the Council, with the suggestion that it would be better "to adopt the Model Bye-laws in their entirety." This the author has advised the Council not to do, and there the matter rests at present.

The Local Government Board, by their action in this matter, instead of helping to secure sanitary regulations of new buildings, are positively hindering local authorities in their endeavours.

Hospital for Infectious Diseases.

In the year 1881, on an outbreak of small-pox in the district, the Local Government Board urged upon the Corporation the immediate necessity of providing a hospital in order that cases arising within the borough might be properly isolated.

The Corporation resolved that a hospital should be erected, if a suitable site could be obtained. The lord of the manor offered a site of two acres upon reasonable terms upon a lease of 14 years, and the work was at once commenced.

The hospital is situate at Deardens, on the extreme westerly boundary of the borough. It stands at an elevation of 60 feet immediately above the river Irwell, and is favourably situated both as to light and air, the two main requisites, whilst the approach to it and the vicinity around is comparatively free from dwellings. The buildings cover an area of 10,505 superficial feet. The whole of the foundations are in brick, with a damp-course of slate and asphalte some 3 inches above the surface of the ground. There is a spacious chamber under the whole of the floors, with a blow-through passage. The whole site of the buildings is covered with a 3-inch layer of bituminous concrete, insuring freedom from damp and vermin. The walls are of wood, double boarded, with a 3-inch cavity between. The roof is boarded, and covered with McIray's patent felt. The inside walls have been painted with silicate paint. The water is conveyed to the building by a line of 4-inch water-mains, and there is provision for flushing the main and for attaching hydrants in case of fire. A constant and efficient supply of gas both for lighting purposes and for heating the disinfecting stove is provided by a 3-inch main.

Arrangement of Rooms.—The wards, on the pavilion principle, are four in number, built in two blocks, connected by a corridor 120 feet in length, the entrance to the administrative department being in the centre of this corridor.

The wards are 24 feet wide, each containing accommodation for 11 beds, with two additional small wards, each containing two beds. There is a total accommodation for 50 beds. Attached to each ward is a day room for convalescent patients; between each ward are nurses' day rooms, from which a view of both wards can be obtained. There is in connection with each ward a bath-room, lavatory, slop-closet, and water-closet. All except the bath-room are divided from the wards by a cut-off passage 4 feet wide, with windows at each end for light and ventilation.

The administrative department contains cooking kitchen, scullery, pantry, four bedrooms, patients' clothes-room, linen-closet, waiting and doctor's rooms, also bath-room, lavatory, and water-closet for the nurses.

In the rear of the administrative department is the boiler-house, wash-house, ambulance-house, and disinfecting-house, the mortuary being built in a distant part of the ground.

Fittings.—The baths are fixed upon wheels, and can be taken to the bedside of a patient when required. The boiler is a wrought-iron saddle-back. The heating apparatus is capable of keeping the temperature of the rooms to 60°, with the atmosphere at freezing point. In each ward and day room, to assist in the ventilation, is one of Bishop and Barnard's patent fire-grates. Ample provision is made for the supply of hot water to the lavatories, baths, and administrative department. One of Ransome's disinfecting stoves has been erected for the disinfecting of patients' clothes, as well as for the general use of the borough.

Ventilation.—The ventilation is all natural, dependent upon the movement of the outer air in the irregularities of weight of the external and internal air. The windows are placed opposite each other; 900 square inches of each window can be opened by the nurse or patient as required for ventilation. There is further, over each window, a space of 144 square inches covered with perforated zinc, which is constantly open to the outer atmosphere. This is so directed that it cannot fall on the patient, but must go upwards towards the centre of the room. The space provided is 1400 cubic feet, and 105 superficial feet of floor area for each patient. There are 15 superficial feet of light space, and 28 superficial feet of artificial heating surface to each patient.

The contents from all sinks, lavatories, slop-closets, and roofs flow over the surface of trapped grids. The soil-pipes from water-closets are double trapped; between the traps is an inlet for fresh air and an outlet for foul air, carried above the eaves of the building. Thus not only is the soil-pipe sealed from the main drain, but a constant circulation is kept up between the two pipes, so that there can be little chance of foul air finding its way into the closet-pan. As before stated, both water-closets and slop-closets are so situate that a 4-foot passage lies between the ward and closet, through which there is a constant current of air.

Cost.—The cost of the building, including sewers, gas and water supply, plumbing and painting, approach roads, disinfecting stove,

heating apparatus, and corridor, is 2400*l.*, furnishing about 700*l.*, making a total of about 3000*l.*, or 60*l.* per bed. Plan of the hospital is shown upon the screen.

Disposal of Sewage.

Up to the present time Bury has not done much towards solving the problem of sewage purification. As will be seen from the drawings exhibited, preparations are in hand, the land for the purification works has been purchased, the lines and levels of the intercepting sewers determined, and the whole of the street sewers which have been constructed during the past five years have been laid so as to connect to the intercepting sewers as designed.

It is intended to precipitate the sewage in tanks and afterwards filter it over the land.

The estimated cost of the works, including purchase of land, is 80,000*l.*

The sewers throughout the borough are laid in easy gradients and in straight lines from manhole to manhole. The ventilation is by the manhole. Chambers are placed at the junction of every cross street, and ofttimes at shorter distances.

The street grids are all trapped and have gullies to prevent the detritus entering the sewers.

The total length of street sewers in the borough is 44¼ miles.

During the last six years there have been, including cross drains, 20 miles of street sewers laid.

Bury is not a water-closet town, but of late years some encouragement has been given to the adoption of this system for the removal of excreta. Still, as the greater portion of the town is upon the midden system and it must take years to alter this, and as the disposal by tips upon vacant land is becoming a nuisance, efforts have been made to dispose of this midden refuse by the erection of a destructor kiln.

Destructor Kilns.

The plant consists of one of Fryer's patent four-celled destructors, completed November 1881, and erected in such manner as to admit of further extension, without material alteration to existing arrangements. The heat evolved from the combustion of the material in the cells is utilised for generating steam in a multi-

tubular boiler, which is used in connection with a mortar mill having a pan of 8 feet in diameter, and capable of grinding about 10 cwt. of mortar per hour, for which there is a ready sale at the rate of 5*s.* per ton. The actual results for the last year's working being as follows: 1312 tons of mortar sold at 5*s.* per ton, realising 328*l.* 4*s.* 3*d.*, which, after deducting working expenses, leaves a balance to the credit of the mill of 52*l.* 3*s.* 9*d.*, one man being employed in working the mill and attending to the engine at a wage of 27*s.* per week of 50 hours. The arrangement is such that the heated gases can either be utilised by passing through the boiler, or allowed to pass direct to the chimney by a flue 5 feet 6 inches by 3 feet, which has been designed, as well as the chimney and other parts of the structure, to allow of further extension of the furnaces. The chimney is 180 feet in height, having an internal lining of fire-brick for a height of 30 feet, of a diameter of 6 feet, which diameter is maintained to the top. The other portions of the plant are an engine-house, store-room for lime, and a high-level road, the latter having substantial retaining walls of stone, and giving access to the top of the cells where the rubbish is tipped from the carts direct to the charging chambers of the furnaces; the width of this road is 12 feet and gradient 1 in 20½, the length 210 feet. The store-room has a capacity for holding 10 tons of lime, and is convenient of access from the mortar mill. The engine-house is large enough for two engines, and contains an 8 horse-power horizontal engine, a workman's bench and other conveniences for effecting repairs to the plant generally. The furnaces are arranged on an incline plane and are charged from the top, and the material, after remaining in the furnace two hours, is withdrawn in the form of clinkers, being reduced to one-third its former bulk; these are used in the mill, and make excellent mortar, the proportion of lime used being one-third to two-thirds clinker. The flues require cleaning out once in two months, and about twenty cartloads of dust are then taken from them. The quantity of material treated in the furnaces per day of 24 hours is about 16 tons, giving an average of 4 tons per cell per 24 hours, or 3¼ cwt. per hour per cell—the total weight of material burnt for the year ending 31st March, 1883, being 4352 tons in 6885 working hours, at an average cost of 1*s.* 8¾*d.* per ton, calculated on actual working expenses, viz. wages and repairs at the depot for the destructor alone.

A staff of four men are employed in the burning of material,

receiving 26s. per week wages of 69 hours, two men for night and two for day working 12 hours shifts and changing each week.

The cost of the destructor, including royalty, was 3500*l*. The drawings upon the screen will fully explain the construction of the kilns, &c.

Sectional Police Station.

As an example of a police station suitable for a small district, I desire to bring to your notice one recently erected in one of the outlying districts, as an auxiliary. The drawings on the screen will explain the general arrangements.

The following is a description.

The elevation to the main fronts is in Yorkshire parpoints, with stone dressings freely interposed; the remainder in pressed brick with stone dressings. The external walls are all cavity walls, bonded with ties; the roofs are covered with blue Vellenhelli slates, nailed to 2-inch red deal laths with copper nails.

The peculiar shape of the site caused considerable difficulties in designing the station and cells so as to fulfil all the requirements of the Government, and county authorities; ultimately these were overcome to the entire satisfaction of both. The principal entrance is in Paradise Street, leading at once into the inspector's or charge office; from this room access is gained to the prisoners' corridor and the policemen's day room. The arrangement of the corridor and cells, is such, that the inspector, whilst in charge of the office, can command a view of both. Each cell contains a cubical area of 830 feet. The brick arch which forms the ceilings and all the walls of the cells are set in Portland cement. The doors are of extra thickness, and lined on the inside with wrought-iron sheets. The windows to the cells are of plate glass, the frames and bars of wrought iron let into stone sills, jambs, and heads. Careful attention has been paid to the method of ventilating and heating. Fresh air is let in to each cell from an area 5 feet wide, by two iron grids, having on the inside regulating covers. Brick flues have been built to each cell, reaching to the top of the building, for the extraction of vitiated air.

The cells are heated with hot water, the pipes being protected by a wrought-iron guard. The boiler-house is placed close to the policemen's dayroom. Lavatories leading from the corridor are provided for the use of the prisoners; each cell is provided with Macfarlane's patent iron water-closets. The drains in connection with

the water-closets are ventilated by a 4-inch shaft going above the roof, with direct inlets for fresh air upon each branch. The whole site of the station is covered with a layer of Portland cement concrete 6 inches thick. The day room or dining room for the policemen is well lighted and fitted up with all the necessary requirements, kitchen range, &c. The staircase to the policemen's bedroom leads out of this room; register grates are fixed in each bedroom. A bath-room is provided with lavatory and wardrobes, for the use of policemen. The inspector's house, with entrance from Horrocks Street, contains large kitchen, with scullery, pantry, and outbuildings, together with three large bedrooms, box-room, and an efficient cooking range, capable of cooking food for policemen and prisoners.

Street Pavements.

Amongst the manifold duties devolving upon the municipal engineer, there is to the author's mind none of greater importance, whether considered from a sanitary or an economical point of view, than the proper construction and maintenance of the highways under his charge. A badly paved and badly scavenged road is an unsanitary and costly work at all times and in all places. The traffic of later years has very much increased, and the wear and tear has increased in proportion. The primitive method of laying down setts of whatever material is at hand upon a bed of loose earth and filling in the joints with sand to be washed away with the after rains, does not meet the requirements of to-day. The inconvenience, the annoyance, the discomfort, and loss which occur, both to the owners of vehicles and the dwellers upon the street, which under this *régime* must constantly be undergoing repair, is a matter that needs consideration at the hands of all local authorities. Much has been done in late years to meet the growing requirements, and Bury, like many other towns similarly situated, has taken up the question in good earnest, and to-day you are specially invited to inspect these works, and to give your opinion with regard to them.

With some few exceptions, it has been determined under the author's advice, to repave the whole of the main thoroughfares with granite setts upon a cement concrete foundation, the joints being run with prepared pitch. The work in progress will be seen in all its stages, but in order to better understand the process, the following brief sketch of the method pursued is given.

After removal of the old Haslingden setts, the underbed, composed of gravel, &c., is excavated to the depth required, and in its place is laid down the concrete bed: the plan pursued in doing this is somewhat after the manner adopted at Liverpool, and described by Mr. Deacon, M.I.C.E., in the 5th vol. of the 'Proceedings.' First is laid a layer of roughly broken stone or shingle about 3 inches in size, upon this a layer of cement mortar, mixed in the proportions of 1 of cement to 5 of clean sharp gravel or sand, and upon this is laid a second layer of broken stone or shingle passed through a 2-inch riddle; the surface is then beaten with large flat iron beaters, somewhat of the form of a shovel, until the whole is thoroughly incorporated; then another layer of cement mortar, and upon this a layer of stone, which is beaten in as before, and so on, until the requisite height and curvature of the underbed is obtained, a thin coating of cement mortar being thrown over the surface, which is then beaten and left smooth, similar to the plaster on a wall; this is allowed to stand about eight days until thoroughly hard before the setts are paved upon it. Care is taken not to mix too much water with the cement. Samples of this concrete have been prepared and will be exhibited, by which it will be seen how thoroughly the stones and mortar are agglomerated by this method. The proportion of gravel and stone to the cement when completed is as 10 of stone and gravel to 1 of cement. The setts are paved with ¼ joints set upon a fine bed of gravel not exceeding ½ an inch in thickness, then the joints are filled in with well washed pea gravel, the setts rammed, and the joints run with prepared pitch.

The following is an extract from the Specification for the supply of cement for this work:

"The cement to be the best Portland cement, finely ground, uniform in quality, and capable of bearing the following tests.

"A. Samples of the cement being sifted through a 6000 gauze wire mesh, must not leave a residue of more than 25 per cent.

"B. The cement must weigh not less than 110 lb. to the striked bushel.

"C. Samples of neat cement will be gauged with a medium quantity of water and placed in the brass moulds provided by the Corporation.

"Within 24 hours of being moulded the cast will be immersed in still water and there remain 7 days from the date of moulding, after which the tensile strength will be tested, which must not be less than 220 lb. per square inch of sectional area.

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"D. The cement when gauged in moulds must not become firm to the finger nail in less than 3 hours after mixing."

Extract from the Specification for the supply of the granite setts:

"The setts to be 5 inches deep and $3\frac{1}{4}$ inches wide, and from 4 inches to 6 inches in length, no four courses when paved close together to exceed 14 inches in width; all setts will be rejected that vary more than $\frac{1}{4}$ inch in depth or $\frac{1}{2}$ inch beyond the length specified, or that contain on the underside a less super area than $\frac{3}{4}$ the area of the face.

"The setts used are from the Welsh Granite Co., the Carnarvonshire quarries of Messrs. Kneeshaw, Lupton, and Co., and from the Derbyshire Granite Quarries, Penmaenmaur, the greater portion being from the latter quarries. These setts from Penmaenmaur should not be confounded with the dark blue slippery setts sent out from these quarries some twenty years or more ago.

"The setts as now supplied, a sample of which is exhibited, are of a clean grey colour, moderately rough on the face, and withal practically limitless in wear.

"The old setts hitherto used are:

"A. Those known as the Haslingden rock, and

"B. A coarse sand grit found in the immediate neighbourhood."

The following table will furnish the relative first cost and cost of maintenance of these classes of rocks:

	First cost.	Cost of Maintenance per year.	Cost per Year over a length of 30 years; first cost and maintenance.
	s. *d.*	*s.* *d.*	*s.* *d.*
Granite	12 0	0 2	0 7
Haslingden rock ..	7 0	1 0	1 7
Sand grit	6 6	1 0	1 $9\frac{3}{4}$

The data being the same in all cases, viz. a 6-inch cement concrete bed, and the joints run with pitch. In the case of Bury, the streets being already paved, the question to be considered was whether it was cheaper to continue the present system of paving with Haslingden rock with an outlay of 1*s.* per yard as against the 7*d.* per yard and the large outlay of from 20,000*l.* to 30,000*l.*

A local authority may with the consent of the Local Government

Board borrow money for the purpose of street pavements, and have twenty years in which to repay principal and interest.

Taking the case of Bury, where the old pavements already existed: 12*s.* per yard first cost of granite, minus 1*s.* 6*d.* per yard over the area for the old material taken up, gives 10*s.* 6*d.* as first cost. Money may be borrowed $3\frac{3}{4}$ per cent., and 7 per cent. will in 20 years repay principal and interest. 7 per cent. on 10*s.* 6*d.* = 9*d.* + 2*d.* repairs = 11*d.* per year for 20 years as against 1*s.* 7*d.* in perpetuity for Haslingden rock, and after this 20 years the roadway will still be in good repair and the whole of the moneys borrowed paid off, and will last another 20 years with an outlay of only 2*d.* per yard per year against the perpetual 1*s.* 7*d.* per yard for Haslingden stone.

Notwithstanding the author has tried to show the superiority of granite pavement in a much traversed street both as to cost and traction, there will doubtless still be in the minds of some, differences as to the kind of rock to employ in their several districts: this he must leave to the Members' own consideration, but with regard to the formation of underbed and the jointing between the setts, his experience tells him in all cases, whatever the surface covering of roadway, that the bed should be hard and even and that the joints should be filled with some impermeable substance.

Wood Pavement.—In the centre of the town two lengths of wood pavement have been laid, the first about six years ago, the blocks being creosoted fir. The work was carried out by Messrs. Armstrong, Addison, and Co., of Sunderland. The cost per yard, including underbed, was 16*s.* 7*d.*, the contractors keeping it in repair for 15 years with an annual subsidy of 8*d.* per yard over all. The pavement has in the wider parts worn well, but in the narrow portion had begun to show signs of wear, but the contractors have recently removed the fir blocks from this portion and substituted beechwood. The second length is laid with English beechwood blocks containing 12 lb. cresote per cube foot; these are laid on a concrete bed similar in all respects to that laid down for the granite pavement: the blocks are 5 inches deep and 3 inches wide, are paved with $\frac{3}{16}$ joints and at an angle of 45° to 60°. It presents a smooth and regular surface, which bids fair to be a successful piece of work. The boon to the shop-keepers in the street is a great one, for not only is the traffic comparatively noiseless, but there is also less dirt, and the saving to horses' shoes, carriage springs, and tires of wheels, must also be considerable.

The cost of the work which has been carried out by the Corporation is 11*s.* 9½*d.* per yard. Messrs. Armstrong and Co. and Messrs. Thubron and Co. supplied the blocks.

Forming, Paving, &c., Private Streets.—The method of procedure is this. By the Bury Improvement Act, 1846, notice is posted up at the ends of the streets to be formed and paved, and, the owners making default, the work is done by the Corporation. The labour is generally let by contract, the Corporation supplying the whole of the material, which is bought by tender at the commencement of each season.

Owing to the want of a clause in the Bury Improvement Act to compel the owner of the land to kerb and level the street before commencement of the buildings, very large quantities of earth have often to be excavated before the normal level of the street is arrived at; this adds considerably to the cost of forming. The stone used is all Haslingden rock, the setts are 7 inches deep, kerbs 12 inches by 8 inches, and flags 3 inches to 4 inches thick. The cost, according to the quantity of excavating required, ranges in paving, including underbed, from 5*s.* 3*d.* to 5*s.* 9*d.* per yard; the kerbing, from 3*s.* 3*d.* to 3*s.* 8*d.*; flagging, from 4*s.* 8*d.* to 5*s.* 5*d.*

At completion of the works the expenses are apportioned to the owners according to frontage in the manner prescribed by the Bury Improvement Act, 1846.

In connection with this class of street there has been executed work to the value of 46,000*l.* in the course of the last six years.

This is a large sum of money to be paid, much of it by small property owners, and the author cannot but echo the sentiment of one of our Past Presidents when he said "that these paving expenses should in some measure fall upon the owners of the soil, it being no uncommon thing for the owner who is receiving 4*l.* per acre for his land as agricultural land, to let that same land for building upon at from 60*l.* to 100*l.* per acre." The owner receives the higher rent, but does nothing towards helping to pay the taxation which is incurred by the improved value of the land, both in the form of paving accounts, and sanitary improvement and other rates.

Town's Yard.—In connection with the streets, sewers, and sanitary departments, the Corporation have established upon the railway with sidings thereto a large store and work yard containing an area of 12a. 1r. 29 perches. All goods are delivered to this yard, and all stone is dressed for street works; all setts are stored

and gauged before led to the streets, and in this way a perfect supervision of all material is kept. There are also stables, harness rooms, &c., for thirty horses. The total cost of yard, railway sidings, stables, benches, stores and offices, and boundary walls, has been to date, 18,648*l.* 10*s.* 6*d.*

Cemetery.—A cemetery and park containing for cemetery purposes 20 acres, and for ornamental grounds 13a. 1r. 27 perches, with the necessary chapels, houses, &c., have been erected by the Corporation, at a total cost of 35,761*l.* 15*s.* 2*d.*

Fire Station.—This is situate in the centre of the town, and possesses its own stables, sheds for engines, tower for drying hose, steam-engines, &c. The total cost, exclusive of land, up to date has been 4000*l.*, with an annual cost of maintenance of 600*l.*

COMPARISONS AS TO COSTS OF VARIOUS MODES OF EXCRETA DISPOSAL.

By Councillor W. C. TUKE, of Bury.

In the year 1879 the author prepared a statement for the Health Committee, showing the comparative cost of the old Lancashire midden privy with the pail closet, which at that time was being adopted at the rate of from 700 to 800 per year. He laid before the committee a portion of the information he now proposes to submit to this Meeting, i. e. the statistics up to 31st March, 1879. For the particulars since that date he is indebted to the Sanitary Inspector, Mr. W. Wilkinson, whose courtesy and attention he now desires to acknowledge.

March, 31st 1874. Up to this date the town had retained the midden privy in all its luxuriant beauty. The number of privies was 7600. The cost of removal was 1842*l.* 14*s.*, or 4*s.* 10*d.* each.

March 31st, 1875. During the year a number of pail closets were put down, but the author is not able correctly to say how many. The total number of the two classes was 7700; the cost 2372*l.* 3*s.* 8*d.*, or an average of 6*s.* 2*d.*

March 31st, 1876. The number of pail closets was 432, and of midden privies 7368. The average cost embracing both classes was 7*s.*

November 9th, 1876. The borough was this day incorporated, and the accounts were made up to date, comprising a period of 32 weeks. The number of pail closets was 500, and of the midden privies 7350. The average cost, embracing both classes, was 4*s.* 8*d.* for the 32 weeks, being at the rate of 7*s.* 7*d.* per annum.

August 31st, 1877. This account includes only 42 weeks, and is the first in which it has been possible to ascertain the separate cost of the two systems. The number of pail closets was 984, and the cost was at the rate of 14*s.* per year for each. The number of midden privies was 6916, and the cost was at the rate of 5*s.* 9*d.* per year.

August 31st, 1878. The number of pail closets was 1687, and

the cost 15*s.* 2*d.* per pail. The number of midden privies was 6313, and the cost 6*s.* 2*d.* per privy.

March 31st, 1879. This account comprises only 30 weeks. The number of pail closets was 2500, and the cost was at the rate of 21*s.* 3*d.* per year per pail. The number of midden privies was 5550, and the cost at the rate of 8*s.* 6*d.* per privy per year.

March 31st, 1880. The number of pail closets was 3291, and the cost 10*s.* 3*d.* per pail. The number of midden privies was 4790, and the cost 6*s.* 6*d.* per privy.

March 31st, 1881. The number of pail closets was 3569, and the cost 9*s.* per pail. The number of midden privies was 4850, and the cost 6*s.* 8*d.* per privy.

March 31st, 1882. The number of pail closets was 3569, and the cost 8*s.* 1*d.* per pail. The number of midden privies was 5006, and the cost 6*s.* 7¼*d.* per privy.

March 31st, 1883. The number of pail closets was 3569, and the cost, including the proportion for the destructor, was about 9*s.* 4*d.* The number of midden privies was 5104, and the cost, including the proportion of the destructor, was about 6*s.* 9*d.*

From the above statement it appears that the average annual cost of each pail closet since 1877 has been 12*s.* 5*d.*, and of each midden 6*s.* 8*d.* But some explanation is needed with respect to these figures, otherwise erroneous conclusions will be drawn from them. The total number of houses in the borough is 10,732, and the number of privies and closets of both classes is 8673, of which 567 are in use in mills, workshops, schools, &c., other than dwellings, viz. 170 pails and 397 midden privies. Deducting 567 privies from the total number (8673) leaves 8106 for use in dwellings. It is therefore manifest that at least 2626 householders within the borough share the luxury of a privy with one or more neighbours. It appears that about 400 pail closets are used by more than one family, viz. for 900 houses, the remainder serving one house each.

The total number of pails at present in use being 3569, minus 170 in mills, &c., leaves 3397 for the use of 3899 families, or at the rate of 1·12 houses per pail.

The total number of midden privies being 5104, minus 397 in mills, &c., leaves 4707 for the use of 6833 families, or at the rate 1·45 per midden privy. These proportions have a direct bearing upon the weight of material removed, but need to be a little softened in their practical application, as the larger privies cost rather less to

empty in proportion to the houses they serve than where one privy serves only one house; so to guard against the erroneous assumption that the cost of the pail system is yearly decreasing, as might be deduced from the yearly statements, it is necessary to know that the system being only a few years old, the first crop of pails (including the stock in hand when the extension was checked) and other equipment is only just wearing out. For the past three years the department has had practically no charges on this account, but the pails are now rapidly approaching dissolution, and unless the system is to be definitely abandoned a heavy cost must be shortly incurred, which will raise the average cost to its normal level.

There is a considerable saving practised by the Health Committee in carrying out this system which no consideration of economy will justify. As the pail system expanded, the charges of the Health Department became so onerous that the Committee decided to abandon the practice of washing the pails, and of employing vans to convey the excreta to the depot; and the pails have since been carried to a barrel cart and the contents tumbled in; and the dirty pails, unwashed, are returned to the closets. Then the barrels bespattered with their unlovely charge, are proudly paraded through the streets to the infinite disgust of the people, whose senses, day by day, are outraged and sickened by the intolerable sight and smell.

According to an estimate furnished by the Inspector in 1882, it appears that if the vans were used, and the pails washed—as in a decently conducted system they would be—the *extra* cost per pail per year would be 4*s.* 5*d.* for labour only, allowing nothing for the extra cost of pails, depots, &c.

Applying these explanations to the average cost of the two systems, the following results appear to be evolved. The author has already pointed out that the average cost of the midden privies for the past seven years was 6*s.* 8*d.* each, with an average servitude of 1·45 houses to each privy. The average cost of each pail closet was 12*s.* 5*d.*, with an average servitude of only 1·12 houses per pail. To properly compare the relative cost it is necessary to reduce the two systems to a common degree of servitude, and the author takes 1·45 (the servitude of the midden privies) as the unit for comparison in each case. Therefore if the servitude upon the pail closets were raised to that endured by the midden privies, the cost would be increased from 12*s.* 5*d.* to 16*s.* 1*d.* per pail. And if

the pails were properly washed and the vans employed, the cost of the complete system would be raised by the addition of 4*s.* 5*d.* to the enormous aggregate of 20*s.* 6*d.* per pail.

The Compound or Modified Privy.

During the past few years the Health Committee, shocked at the increasing financial load imposed by the pail system, have cast about for some plan embracing the economical advantages of the midden privy without its unsanitary objections, and have, as a kind of compromise, been constructing what they term "modified privies," whose characteristics are said to be (1) protection of the closets from outside moisture; (2) protection of the surrounding earth from fæcal soakage from the inside; (3) complete admixture of the ashes and fæcal matter within the midden; and (4) ease of removal. I need not enter into any description of this privy, which is certainly a great improvement upon the old midden privy. It has nevertheless the disadvantage of requiring the excreta to be carted through the streets, and the cost of the removal, so far as the Inspector can judge, is about the same as the midden privies, 6*s.* 6*d.* to 6*s.* 8*d.* per year.

The Slop-water Carriage System.

This is the system in use in Bristol, Salford, and Hyde, where the Bury Health Committee investigated it a few years ago. In 1879 the author recommended that a trial of the systems should be made in Bury, and 81 of these closets are now in use in the borough. There is no need to describe the closet further than to say that it is a deep stoneware hopper, terminating in a syphon bend, above which the slop-water from the grid in the yard empties itself. It is found that in most cases this supply keeps the closet clean and sweet, but when any stoppage appears, a bucket of water thrown down clears the obstruction away, except where it occurs in the insoluble form of a scrubbing brush, boot, or other kindred matter. The author is not concerned this morning to deal with the subject from any but a mercenary point of view, so will proceed at once to demonstrate the economy which would follow the general adoption of the system in Bury. From the Sanitary Inspector's unpublished report for the current year, he finds that 2758 barrels of excreta were removed from 3569 pails, at a cost of 5*s.* 9¾*d.* each; and 4469 loads of rubbish also from the pail closets,

at a cost of 4*s.* 2¾*d.* per load. This shows an average of 1·22 loads of dry rubbish per pail closet per year, equal to 1·58 loads if the servitude were equal to that endured by the midden privies. From the 5104 midden privies was removed 12,175 loads of rubbish, giving 2·38 loads per privy per year, at a cost of 2*s.* 6*d.* per load. Deducting the "reduced" weight of dry rubbish from this —ascertained by the pail closets to be 1·58 loads—it leaves 0·80 loads per privy, which must be excreta or extraneous matter. This, multiplied by the number of privies, gives 5104 × ·80 = 4083 loads of excreta annually carted from these privies, besides that left to saturate the dry ashes and soak the surrounding ground. The saving to be effected if the slop-water system were generally adopted, seems to be as follows :—

	£	*s.*	*d.*
2758 barrels of excreta, now conveyed from pails and costing 5*s.* 9¾*d.* each, would go down drains	801	10	10
4469 loads of rubbish, now costing 3*s.* 3*d.* per load, would, if removed in bulk and in daylight, cost only about 2*s.*, or a saving of 1*s.* 3*d.*	279	6	3
4083 loads of excreta, now carted from the midden privies, at a cost of 2*s.* 6*d.* per load, would go down the drains	510	7	10
8092 loads of rubbish, now removed at night at a cost of 2*s.* 6*d.* per load, would then be removed in daylight. This would save two-ninths of the wages of the men, and the whole cost of lamps, oil, carbolic powder, &c., besides the fact that the men could, and would, do much more in daylight than they do in the dark, save say 20 per cent. or 6*d.* per load	202	6	0
Total saving	£1793	10	7

As the total cost of the night-soil department, exclusive of the destructor, was this year 3065*l.* 8*s.* 9*d.*, it appears as if it might be reduced in round numbers to 1300*l.*, or an average cost of 3*s.* per closet, and this agrees very nearly with the Sanitary Inspector's experience; he estimating the cost at 3*s.* 2*d.* per closet. Against the saving to be effected by the slop-water system must be set the extra expense of treating the effluent in any system of sewage purification. The author has no practical experience of this cost, but so far as he remembers the Rivers Pollution Commissioners' reports they made very light of the increased impurity of the sewage of water-closeted towns over that of the North of England towns where ash-middens are general. The first cost of constructing a slop-water closet is no doubt a few shillings higher than the cost of forming a modified privy. The cost of converting a

midden privy into a modified privy is about 30*s.*, and the author supposes the cost of conversion into a slop-water closet would be under 2*l.* As the cost of constructing a properly equipped pail closet is much more than this, the question of first expenditure need not be a hindrance to its adoption. The author has tried to lay before the Meeting nothing more than the actual facts ascertained from experience, without commenting upon or drawing conclusions from them, and now leaves the application in your hands, who are by trained experience far more competent to deal with them than he can possibly be.

DISCUSSION.

The PRESIDENT: I think it will be convenient now, perhaps, to take what discussion is practicable upon the two papers read. But in the first place you must allow me to congratulate the District Secretary and Mr. Cartwright upon the splendid attendance, which I think could not possibly be equalled in many parts of the kingdom. With regard to the discussion, I would suggest that the remarks be as short as possible, seeing that we shall have to visit a number of works. A reporter will accompany us, so that perhaps the most profitable part of the discussion will take place upon the spot. I hope that the paper of Mr. Tuke will be printed in full.

After some little conversation as to whether the discussion should be taken then or deferred, it was resolved to take the discussion upon Mr. Tuke's paper.

Mr. ALLISON: I think we must all feel obliged to Mr. Tuke for the able and instructive paper he has read. There is only one thing I would mention. In Bury they depart from the old privy system. The great drawback in that system was that it was impossible to make an impermeable bottom, and where it was adopted the people were living upon a site saturated with filth. It was impossible to confine the filth in a midden, as it oozed out from year to year; and if it got out it spread, and you never know where it goes to. There was one point Mr. Tuke did not sufficiently explain as to the modified ashpit. I want to know whether it is of restricted size, with an iron tank impermeable at the bottom, so that no leakage could foul the soil. As to the system of water-carriage, called "Fowler's System," he did not go into the difficulty which turned up at the extreme end in dealing

with it. We are all agreed that the simplest and cheapest and best of all systems is that of dealing with it as sewage on the water-carriage system, if we were not tripped up at the outlet and compelled to deal with it there. When it is discharged from the sewers you cannot put it into the rivers or tidal streams; you have to precipitate it or deal with in it in some other way which entails great expense.

Mr. Fowler: I feel very much indebted to Mr. Tuke for his very able paper, which will prove very interesting to read, but not having it before us we cannot deal with the whole figures. The system of water-carriage as described, I claim as a patent, and have paid all the sums due for it, and claim royalties upon it. I do not know if the system in force in Bury is quite the same, but I may say that my system is fully protected. I have studied it for many years, and went into it fully, and found what Mr. Tuke has found. It is a great stride in economy in passing this matter to the place of outfalls. If you come to consider the matter and take the statistics of health you find that the system has a great value. For instance, London was in 1847 visited by a great plague, I think of cholera. London had then a midden system in operation. An Act was passed to do away with the whole of the midden system. The work was done promptly, and the system cleared away in a short period. From that day to this I believe London has been the most healthy city in the world. The death-rate never fluctuates, but is most steady. With our most strenuous efforts to reduce the death-rate, the London rate remains at about twenty, whilst the rate of other cities runs at times up to forty or forty-five. It is inhuman to employ people to empty these tubs: it is not right; it is not civilised. We say that Manchester is a model of sanitary reform. Manchester has done nothing, practically speaking, to mature or raise up a standard of sanitary reform. It simply collects the whole of the night-soil and leaves it in the town. The sewage and filth goes into the Irwell. Do you think Government will continue to allow it? Salford is utilising the sewage. Do you think Manchester will be allowed to continue to act as it does? Manchester has gone to an enormous expense in scavenging at the town end of the sewers; they have only half done their work, so to speak, by scavenging at one end; and Manchester will have to scavenge at both ends, and will be at the same cost as for the other. Manchester must bear this in mind; it will not long be allowed to do what it is now doing. Supposing Manchester

was cleared of all the dwelling-houses and brickwork, and we got above in a balloon, and looked down upon these tubs they are using: what would we look upon but a set of manure heaps in a field. The germs of disease are being sown, and it takes the whole time of the doctors to keep them down. Do you mean to tell me that the air of Water Street, Manchester, is as pure as in the city of London? No, it cannot be. Then in the next street there are abattoirs, and the greatest care is taken; but these germs of disease, although infinitesimally small, float about, like motes in the sunbeam, and that is the way disease is spread. Typhoid fever is not spread in the patient's room, but by germs from the vessels. That is well known. Dr. Teal, a great authority, has told us this. We should not store up in our ashpits, we should not store up in these fearfully pestiferous places and allow the germs to continue to spread. The whole system is wrong from the beginning, and it is wrong to allow men to empty into such receptacles. Then it has been found that these men have taken these tubs back in a dirty state, and placed them within a few feet of the dwellings and the people who use them. I am speaking from experience of thirty years. Do not let us strain at the shadow and let the substance pass. The system I have proposed is perhaps the simplest and best. It does not use the town's water, and yet it gets perhaps twelve times the amount of water that is ordinarily allowed for a water-closet. It has been taken up by many persons. Major-General Scott and Baldwin Latham have spoken in favour of it, and so have others. I should not have said all this but for the paper of Mr. Tuke, for I do not give it as a sort of cheap advertisement at all; and I offer my humble thanks to Mr. Tuke for his able paper.

Mr. Allison: I wish to make a few remarks on what Mr. Fowler has said with regard to the midden and privy system and the water-carriage system. I speak of the cost and cleanliness all round. He does not give Manchester fair play when he attacks the midden system. He must have heard of these pails being removed once a week, and before the end of the week there was no nuisance at all. The great danger was from vegetable matter, which other places besides Manchester, such as Newcastle, allowed to be thrown into the ashpits and to accumulate for three, six, and nine months at a time. Those are the accumulations from which the greatest danger arises.

Mr. Jerram: It would be a pity that the discussion should be

closed, because it is in discussion we elicit information that is useful to us. I think we are indebted to Mr. Tuke for the statistics he has given us as to the cost of the pail system. In the South of England we have advocated the water-carriage system for years, and this is the first time at any of our meetings that the cost of the pail system has been mentioned. I have tried to get the cost at Manchester, but have never been able to get hold of the cost of the removal of the excreta and its manufacture in that city. We have been told to-day the actual cost of the pail system. We find that the actual cost of the pail system is 20*s.* 6*d.* per closet, but we all know that 1*l.* per closet will go a long way towards providing a sewage system in any district we have to contend with. When we remember that the amount of sewage thus taken away by the pail system is infinitesimally small compared with the quantity of sewage to be dealt with, we see the increased cost that gives. The quantity of sewage dealt with by this pail system is small, because the larger bulk of sewage consists of slops and greasy water from the slop-stone pipes, which went into the rivers and polluted them. If the Rivers Pollution Act was strictly carried out they would not be enabled to take part of their sewage away, and send the larger portion into the rivers and streams. It is therefore gratifying to see that the pail system is a failure, that it is indecent and not conducive to health. They might get plenty of land a short distance away for sewage disposal, where they could raise vegetables as Birmingham has done, as well as other large towns, and from what I have seen in other towns, I feel that the matter is not so difficult of solution as some imagine.

Mr. Spencer: We are pretty well agreed with regard to the old privy system. It is like thrashing a dead donkey, to go on with a condemnation of the system. But, unfortunately, unlike dead donkeys, which are scarce, these privies are plentiful in many towns, and it appears to be the inclination of many Members of this Association to saddle upon the towns of the North of England the adoption of this system. At any rate, other towns will have accumulations of refuse, and the question is how are they to be got rid of. That is got rid of in the South of England, where the closet system is in vogue, by keeping the ashes and other filth, except excreta, in the houses themselves. In the North of England the ashpits are outside, while in the south they are inside. A fearful looking creature, with trousers strapped at the knee and tremendous boots, knocks at the front door and calls for the purpose of clearing away

the ashes, cabbage leaves, decaying fruit, and other things. He loads the basket much fuller than it ought to be, and leaves a track right through the passage, and through the front garden, if there is one, or area, and across the footpath. He tips the basket into a high cart, when about one-third of the contents fall over on the other side. It is scarcely attempted to be maintained that the collection of refuse, decaying vegetables, and other matters which have accumulated for many weeks together can be innocuous, although I admit that the addition of the excreta would be a great addition to the nuisance. A complete water-closet system in the poorer class of dwellings in large towns—and those are the most important class of dwellings—would not get rid of the nuisance arising from ash-pits. We are a long way from having a perfect system of water-closets, and if we had, there would still be the refuse to deal with. You must not be led away to think that the adoption of the water-closet system will attain the object we are discussing. As to Mr. Tuke's paper, it is impossible to discuss the cost without enlarging the discussion to some extent upon the subject generally. Now there is another question which arises, and that is with regard to the water supply. That is in many cases in the hands of private companies; in many cases it is inadequate, and the charges are exorbitant. You must not forget, in estimating the cost of water-closets, to put down a large sum for the supply of water, and you must not forget that the supply in itself is inadequate. You find that many people estimate the supply of water for flushing at two gallons. That is one-third too little, and you should have six gallons of water for flushing to keep the closets in an efficient state. I am referring to inside closets. It appears from what has fallen from Mr. Tuke, Mr. Fowler, and others, that we shall have to take in a new element with regard to slop-water closets, and that is the royalty. Perhaps in Mr. Tuke's estimate that was not taken into due consideration. What the royalty is I do not know, but perhaps we shall be enlightened. Slop-stones were generally on the ground floors, so that where you have water-closets in the upper stories you will require a sufficient supply of water. As an improvement on the horrible privy system we ought to welcome it as a step in the right direction; but we must guard ourselves from arriving at the conclusion that the water-closet system has solved the question. The slop-water closet system may be put out of order mechanically by neglect or interference. In the middle class and better class houses they were better looked after, but in the poorer houses

before they had been in operation many weeks they were thrown out of order, and the nuisance became worse than ever. I do not wish to advocate one system or the other, but to put the question on a broad basis, so as to have both points of view and all sides. I clearly think you may have both systems side by side, if you have an efficient system of collection.

Mr. Lobley: It is well known to all who have had anything to do with the Rochdale pail system that it is very costly. I have not before seen it put down at so high a price as 12*s.* 6*d.* a pail, and even increasing to 20*s.* per house. I find that the cost of the pail system in Hanley is 4*s.* 6*d.* per pail. There is a modification of the ordinary system to account for that low figure, which is the use of the divided pail. Messrs. Turner and Robertshaw have adopted this principle and patented several improvements. A perforated division is placed in the pail, and liquid matter flows off into the sewers; I have found no objection to it; there is no slop-water to cart away, and the cost of collection is reduced. I shall be met with the reply that the quantity of urine is reduced, and therefore the excreta was less useful to the farmers; but the farmers did not pay the cost of collection, and therefore ought not to be considered. The introduction of pails is no doubt a great improvement on the old middens, and I can only look at it in that light. I think the water-carriage system the best. Mr. Allison said, we ought to consider the cost of the outfall works, but I do not endorse that view. In my own town there is a capital expenditure of 20,000*l.* for dealing with the sewage, although it is not a water-closet town; and if all the pails and privies were done away with and water-closets substituted, it would not increase the cost of the outfall works by more than 100*l.* a year. The great bulk of the nitrogenous matter is contained in the urine, and the greater portion of that goes into the sewers; but the solids removed by the pail system at great expense is exactly that material which can most easily be taken out at the sewage works. I therefore do not think that the expense of the sewage outfall works ought to be considered in its entirety against the cost of collecting in the other way. In the district we have tried the slop-closet, which is there known by the name of Fowler's closet. We find no particular objection to them, although we now and then get old waistcoats, rats, and cats, &c., out of them. I agree that no cesspool can be constructed which can be guaranteed impermeable, and the subsoil is therefore always likely to be contaminated.

London was referred to by Mr. Fowler as a healthy town, and that is in spite of the fact that the water-closets are notoriously bad. You turn a tap, there is a dribble of water of a corkscrew pattern, which is anything but sufficient for flushing purposes. How much better would it be if the closets were well constructed and well ventilated with good flushing. I say positively, that nine out of ten closets in London have nothing like the two gallons of water for flushing purposes which are usually considered to be required. Allusion has been made to the collection and cost of ashpit refuse; it is true that the water-closet system will not deal with that, nor will it deal with street paving and a few other things; the cost of ashes removal should not be mixed up with the water-closet system. I do not think it is necessary to wait for a perfect system which cannot get out of order, for we find in Liverpool, which is densely populated, the trough water-closet system in operation, and when it is looked after by an inspector it has been shown to be much better than the pail system.

Mr. Tuke then replied upon the discussion. He said he agreed with much of what Mr. Allison had said as to the objections to the modified closets, which had no iron tanks, but the bottoms were lined with cement. He thought they were altogether a nuisance, and ought to be dispensed with. He simply gave the particulars to show the cost of one system compared with the other. Mr. Lobley had spoken of the cost of the system at Hanley being only 4*s.* 6*d.* If it were so, they must have a much better system than at Bury of removing the ashes. (Mr. Lobley: That is the cost of removing the contents of the closet only; not of the ashes.) But his (Mr. Tuke's) figures were for the removal of the whole contents of the ashpit, ashes included. Nearly all the closets were behind the houses, and ventilated, and nothing from decaying matter could well get into the house unless considerably diluted, from the closets on the water-carriage system, in which case evacuations from a fever patient were not very liable to infect. He did not know what Mr. Fowler would think about the infringement of his patent. They only knew that the system had been in use in Hyde for over twenty years, but if there was nothing to prevent Mr. Fowler claiming a royalty he hoped he would be merciful. Something had been said about the great extra cost of dealing with the sewage at the outfall, but he had always understood that there was little extra cost in dealing with such sewage over and above what was incurred in dealing with the slop water alone.

TRAMWAYS RECENTLY LAID AT BURY.

By R. VAWSER, M. Inst. C.E., Manchester.

The Bury and District Tramways were authorised by Provisional Order and sanctioned by Parliament in 1881. It then consisted of about $8\frac{3}{4}$ miles of tramway route, but now forms part of an extensive system having an aggregate length of about 54 miles, for which Mr. J. W. Newton and the author are joint engineers. The mode of construction was described at a meeting held in Rochdale some months ago, and full particulars will be found in the 'Proceedings' of the Association for the last year. The author may, however, explain that the whole width of paving repairable by the Tramway Company as well as the space under the rails is laid with 6 inches of Portland cement concrete, and the rails are solid steel rails on the principle known as Gowans' patent rails, and weigh 93 lb. to the yard.

The whole of the tramways authorised by the Bury Tramways Order are now open for public traffic, but the experience of a few months does not fully solve the question of working cost, and the author cannot at present give any reliable information on this important subject.

There will be several depots and repairing shops in convenient centres on various parts of the system; the principal depot will be in Bury, and is now rapidly approaching completion. This depot affords accommodation for fifty-two engines and cars, and has cost about 8000*l.*; it will contain workshops and machinery for effecting ordinary repairs; and stables for the few horses required for working a short length of tramway. These stables will eventually be converted into additional sheds for engines and cars, and the whole system be worked by steam power.

The design, working arrangements, and management of a steam tramway materially differ from a horse tramway, the rails and permanent way which was sufficient with light horse cars, is found to be entirely unsuitable for the more heavy loads due to steam traction; in the same way the depot and sheds involve the consideration of new features, and altogether the question of tramway

construction and management has become closely assimilated to railway practice.

The depot over which you will shortly be conducted is in partial occupation, but it is not complete. When finished it probably will be one of the largest steam tram depots in existence.

Two special features in connection with the rolling stock on these lines deserve separate mention, viz. the system of central support and flexible wheel base designed by Mr. J. W. Grover for the carriages, and the engines which are according to Wilkinson's patent, a full description of which appeared in the 'Proceedings' of the Association for last year.

Flexible Wheel Base.

Mr. Grover sums up the leading advantages thus :

1. Double the ordinary wheel base, whereby great steadiness is obtained, with little overhang at ends.

2. Central support on the rail by large wheels, hence great strength of structure without trussing, and reduced traction.

3. Flexibility of wheel base, the axles radiating on the curves, so that curve friction and jerks are avoided.

An ordinary full-sized tramcar is about 24 feet long, and has four points of support 5 feet or 6 feet apart, hence there is 9 feet of overhang at each end of the car, which not only renders it unsafe, but causes it to feel the inequalities of the line very much, and is very destructive to the road; this is aggravated if the springs are at all easy, by increasing the pitching motion of the car, and causes a succession of jerks in passing round a curve.

By increasing the points of support to six, and placing them twice as far apart, the vehicle is rendered more independent of inequalities in the road, and the dangerous overhang and jerks are avoided, the vehicle running as firm and steady as a railway carriage.

Some of the advantages of a flexible wheel base are secured by the adoption of double bogies like those in use on the Pullman cars, but these do not provide the central support to which Mr. Grover attaches much importance, and they require eight wheels 1 foot 9 inches in diameter, whereas six wheels suffice for the flexible base, and the centre wheels, which carry half the load, are made much larger than the bogie wheels, thus diminishing the tractive resistance.

Since the first of these cars was built it has been arranged to adopt spiral springs instead of laminated springs for the central wheels, and the means of applying the breaks has been greatly simplified, and their efficiency increased.

It is an open question whether the flexible base, or the double bogie is best adopted for tramway purposes, but there is little doubt some of the recent accidents would have been avoided if either had been applied.

The road and rolling-stock on these tramways will be found to embody the most recent improvements, but the subject of traction power is certainly not yet solved : the author has every reason to believe that great improvements in the engines will shortly be developed ; and judging from recent experiments, there is every reason to believe that tramcars will at no distant day be propelled by electricity.

At the close of the discussion of the papers, the Members were entertained at luncheon by his Worship the Mayor of Bury (Alderman J. Duckworth, J.P.), after which the Manchester, Bury, and Rochdale Steam Tramway Co. kindly placed a special engine and car at the disposal of the Association, who made a trip along the line in the direction of Manchester, for about 2½ miles. Prior to starting, many of the gentlemen examined the construction of the engines and the flexible wheel-base of Mr. J. W. Grover, and the excellent way in which sharp curves were taken. On the return, the system of paving as described by Mr. Cartwright was examined. A visit was next paid to the widened and extended bridge at the foot of Bolton Street, and to the Corporation Gasworks, as described in the paper. Next Fryer's Patent Destructor, the Sectional Police Station, and the Tramway Depot were visited. A general approval was given of all the works seen, the arrangements and the class of work being well spoken of. Afterwards the Members dined together at the Derby Hotel, where Mr. Jones stated that he had erected the first Destructor in the South of England, but it did not work very well, and he came to Bury especially to see the one there, and found what he wanted—that Mr. Cartwright had remedied the defect he noted, and which had not been done by the constructors.

DISTRICT MEETING AT CARLISLE,

September 28th, 1883.

Held in the Town Hall, Carlisle,
Mr. H. U. McKie, *City Surveyor, Carlisle, in the Chair.*

THE DISPOSAL OF HOUSE REFUSE.

By J. P. SPENCER, C.E., Newcastle.

The question of the disposal of house refuse having frequently come before the Members of this Association, and apparently without any unanimous conclusion having yet been arrived at, I think it may not be out of place to raise a brief discussion on a subject which is not only important in itself, but appears always to bring out a free expression of opinion and a considerable variation of sentiment, whenever it is introduced.

Too often these discussions have been allowed to lapse into the controversy as to whether the water-carriage system of the disposal of sewage, the pail system, or some modified form of either of these was the best; but it must not be forgotten that in cases where the sewage has been disposed of in the best form of water-carriage operations, the ashes and other refuse remain still to be dealt with.

In this paper it is proposed to touch on the question of sewage disposal to a very small degree, and only as bearing upon those classes of dwellings where the present water-carriage system is found by experience to be scarcely suitable.

The condemnation by sanitary reformers of the old style of ashpits or middens is now universal; but it is not so many years since it was thought the best and most approved method of disposing of refuse. Unfortunately while the workers and thinkers in sanitary science are active and anxious for the public health, the Legislature is, as usual, a long way behind.

All sanitary engineers, all medical officers, inspectors of nuisances, medical men generally, and all thinking and intelligent members of the community condemn the system known as the privy and ashpit; yet the Statute Book requires that such shall be provided, and there it stands.

The first step in the right direction appeared to be an effort commenced about fifteen years ago, to so construct these ashpits as to cause the ashes to fall upon the more offensive contents, and to some extent absorb the gases. This, however, was not found to be practically effective, and moreover it assumed the principle that the accumulation of refuse for many days and even weeks was inevitable. This must be wrong, and any mode which favours the accumulation for more than two days should be discountenanced. Nightly removal would be better, and is by no means impracticable either on the score of expense, or for any other reason.

The first suggestion of the pail system appeared to come from Rochdale, where it was at once commenced on a large scale, and has since been greatly improved and developed. Here, however, the collection of refuse is in large tubs, separate from the privy pails; and this again would seem to involve a somewhat prolonged accumulation. If so, it is a mistake, as next to the immediate removal of sewage comes the daily removal of refuse.

It may by this time be inferred that the object of this paper is to recommend the nightly removal of house refuse and the avoidance, at any reasonable cost, of a prolonged or large acumulation on the premises.

Up to the present time I am not aware of any better mode of accomplishing this than the pail system. This plan to be successful should be carried out in conjunction with efficient drainage; because if no proper gullies and drains be provided the temptation will arise, among the poorer classes, to throw slops into the pails. This would greatly detract from their usefulness and probably cause them to become a nuisance. Hence it is certain, that the present pail system is by no means perfect, but it must be acknowledged to be a great improvement.

The question whether or not the excreta should be allowed to go into the pail is open to doubt; if it be so, by far the best mode is to have only the pail, and to allow the execrata, the ashes, and other refuse to be all put into it.

This is the least offensive, the least costly, and probably the least unhealthy process.

A large proportion of the gases are absorbed by the ashes and dry rubbish, and the latter also constitute a convenient vehicle in the form of which to convey the refuse away. As a rule this also prevents the pails from becoming very dirty, and a free sprinkling of deodorising powder is generally all that is required.

Where water-closets can be provided the nuisance liable to arise from the refuse pails should be really a minimum. Unfortunately, for the lowest class of dwellings, no suitable water-closet has yet been invented and, failing this, the next best thing appears to be the pail system.

A great objection appears to be taken to the alleged nuisance caused by the vans conveying the pails through the streets: this applies chiefly to what is known as the separate pail system.

The ordinary ashpits are now generally cleaned out at night time, and no great nuisance, in a properly managed town, ever arises from the conveyance of the contents through the streets at night. The only nuisance is where the refuse heap has temporarily lain on the street, or where from neglect the ashpit has been allowed to remain too long a time without being cleaned out. This on the pail system would be abolished, and there is no valid reason, in most towns, where back lanes exist, why the contents of the pails should not be emptied into ordinary carts every night and conveyed to the depot.

Having got the refuse to the depot the next question is, what to do with it.

In country towns the distance is not too great to have the depot in some suburb where it cannot be a nuisance, and there it may be allowed to remain until gradually taken for light manure by farmers.

In large towns the distance is too great, and if no sale can be obtained for it, in its crude state, it should be burnt. There is now no difficulty in disposing of it in this way, as suitable destructors have been established in many towns and have been often inspected by the Members of this Association.

The question of cost is no doubt an important one, but the question of health is more important.

At the last District Meeting of the Association held at Bury, a very valuable and instructive paper on this subject was read by Mr. Councillor Tuke, and from it we gathered that the cost of the pail system in Bury was something like 16*s.* per pail per annum. This included cartage and every legitimate charge. It was not

stated whether any special circumstances rendered the cost greater in Bury than elsewhere; but the author's experience is that in some other places the cost is not so great. In the borough of Tynemouth, for instance, the cost is only 7*s.*; in Birmingham it appears to be about 15*s.*, and doubtless there are Members present to-day who can inform us of the cost of their district. In judging of the relative costs, however, it should be borne in mind that if water-closets were at once substituted for every pail closet in a district, the refuse would still cost a great deal for disposal in the aggregate.

In speaking of the cost as above, it is only right to say that in Birmingham the pails are removed in vans and cleaned, whereas at Tynemouth they are not, and should that be done at the latter place an additional annual cost of about 4*s.* per pail would have to be added. Of course the cost must depend to some extent upon the distance from the depot and other local circumstances in each town, but the writer estimates that an average cost of 12*s.* per pail per annum is amply sufficient to include daily removal and cleansing of pails sufficient to prevent nuisance.

The cost of cleansing the pails is no doubt very great, but where the excreta and the ashes are all put into the same pail, and reasonable care is taken to provide drainage and keep out slops, it will be found unnecessary to remove the pails to the depots for cleansing, except at intervals in the very poorest neighbourhoods. Where cleansing becomes after a time necessary, the author suggests that in the case of galvanised iron pails, it would be better to use heat instead of water for the purpose.

A proper drying process, which could be easily devised if a destructor furnace were on the premises, would speedily destroy any injurious attachment or incrustation. In the case of wood pails a simple sluicing with a hose would be a less effectual but still perhaps a sufficient mode of cleansing. Like everything else the pail system requires a little tact and management in the working, and this is, it may be presumed, one of the duties for which inspectors are engaged.

The first cost of construction of the pail receptacles is very small, for where the cost of a water-closet with ashpit attached would be over 20*l.* or the cost of a privy and covered ashpit 17*l.*, the cost of a pail closet would not exceed 10*l.* built of brick, and roofed in, and including 4*s.* 6*d.* for the cost of the pail. This should fall upon the owner, and he should be required from time to time to renew

the pail when worn out. A pail will last, however, for many years.

Like every other reform, the pail system of disposing of house refuse has, and no doubt will still have many difficulties surrounding it. The mere fact of the gradual favour that the "combined" pail system is gaining over the separate system, on the question of sentiment or nuisance, is a proof that it is gaining headway. The only, though vital and important argument, in favour of the water-carriage system of sewage, viz. its immediate removal from the premises, is the same which forms an important element in the pail system of refuse removal; consequently those should carefully and impartially consider the one, who consistently advocate the other.

Above all things it is to be hoped that no difficulties or expense —either temporary or permanent—will ever induce any sanitary authority to return to the unsanitary and dangerous system of fixed ashpits. No argument, and certainly, no reason, can be found to justify such a course, and whether they be constructed as privies or as ashpits only, and on some modified or even improved form, so long as the principle of them involves the accumulation and long detention of the refuse, they must be wrong. No precaution can really be taken to render them innocuous, and even if they be lined out with cement, which will crack, or sloped inside, which will leave a sharp furrow at the bottom for liquid refuse, or sunk into the ground, which will cause percolation; or kept above the ground, which will cause leakage upon the surface, they will surely remain offensive, less, only in degree, than the old unhealthy privy and ashpit which has, in times past, slain so many thousands.

The writer therefore ventures to recommend all concerned to avoid any kind of fixed accumulative ashpit, whether ancient, modern, or modified in type, and to insist upon such a practice as will entail a removal every second day, and enable it reasonably to be done literally every day whenever considered expedient in consequence of infectious disease or other causes.

The important question of refuse disposal as well as of sewage disposal, is yet far from being fully developed, and is still in a transitional state; hence none of us can afford to be dogmatical, and these brief and somewhat crude remarks are put forward expressly for the purpose of raising discussion and eliciting useful information, and not by any means with the idea of propounding a settled practice. The author, however, ventures to advance them in arrest

of hasty judgment and premature condemnation of the pail system; and, while he leaves, on the present occasion, the advocates of the separate system of pail closets to defend their practice, he has no hesitation in recommending the pail system for the reception and removal of house refuse, whether it be used as an ash-bin only, or as a combined privy, ashes, and refuse receptacle; and if such a mode of refuse removal cannot be approved by all, it is hoped that at least until some better method is propounded, its present merits will be recognised.

DISCUSSION.

Mr. Laws: I had recently an opportunity of visiting Nottingham and saw how the pail system was worked there. There is one point in which I cordially agree with Mr. Spencer, and it is, there should be no separate pail system—the whole of the refuse should be put into one pail. I know that the amount received for manure is a temptation to corporations, but that is a fluctuating trade. At Newcastle, at one time, they received 3000*l.* a year for the manure, but now they get scarcely as many hundreds. My impression is that it would be false economy to lay out money with the view of making a profit out of the sale of manure. It might pay for a few years, but the sale would drop off, and the Corporation would be left with the plant on their hands. In Nottingham they make the manure a very serious item in the matter, and they get a large amount per annum for it. They have machinery which cost several thousand pounds to manufacture the manure. So long as all goes right it will be a good thing, but I am afraid the trade will not be permanent.

In Nottingham they have something like 25,000 pails, and they clean about 5000 of them every night. They take the pails to the depot in special carts, and they are there washed with water at high pressure, and returned. By this system, the removal of the refuse took place about once a week—certainly on an average not more than once in five days. They have a special pail, coloured in a special way, which is sent to all houses where there is any enteric fever or infectious disease. The medical officer of health gives a note to the the proper quarter, and these "infectious" pails, which are supplied with a special disinfectant, are supplied to the houses where the disease exists, and their use is continued until it disappears. The contents of these pails are

not mixed with the ordinary stuff, but put into a destructor and burned. The cost of the pails used in Nottingham is extremely small. They get oak pails, which are very substantially made and hooped with iron, at a cost of 2*s.* 8*d.* each. These pails, which last about three years on an average, are the cheapest pails I have ever heard of. Galvanised pails wear out more quickly and are a great nuisance in some ways; for instance, they are very difficult to destroy, whereas the oak pails can be put into a destructor and burned. In Nottingham, the cost of removing the town refuse is 20,000*l.* a year, and 6000*l.* a year is recovered for the manure sold. I made inquiries as to whether there was any objection on the part of the owners of property to altering their ashpits to suit the pail system, and was told that there was no objection whatever, and that the authorities had in no single instance to resort to law to force it upon them. The manure is distributed over a radius of something like twenty miles from the town by barge and rail, and about 3*s.* per ton is paid by farmers for the ashes and refuse ground together. The Corporation finds the pails. I do not remember the name of the maker, nor the cost of grinding. The ashes and the excreta are sent away together. Mr. Richards seemed to think that the best way was to mix them.

The CHAIRMAN: I understand that the Newcastle Corporation does not realise anything for the refuse of the city.

Mr. LAWS: We have to put the refuse on the trucks, and we are very glad to get rid of it in that way.

Mr. GORDON: At Leicester something like 7000 pails are in use, which means that one-third, if not one-half the town is supplied with them. As in other towns, the authorities found difficulties at both ends. The pail system was introduced with the view of avoiding as much as possible further pollution of the river by the effluent from the sewage works, and the system adopted was this: The pails are removed and renewed once a week. Something like 1000 are removed nightly in closed vans made for the purpose, in order, as far as practicable, to prevent the exhalation of bad smell as the refuse is being conveyed through the town at night. They worked the pails entirely on the separate system. The difficulty arising in large towns to the mixed system was the disposal of the manure. It might be worked with a profit in an agricultural district, with a truck system, but even then there would be a large loss upon it, which would have to be made up, of course, out of the rates. At Leicester, the object of the authorities

so far had been to make the system pay the cost of collection. I am sorry to hear that the pail system has not paid at Nottingham. In Leicester the pails hold about 13 gallons, and they are sent into the country in vans. About 6*d.* per pail is paid on the average for the contents. They were not able, however, to dispose of the whole of the excreta in that way. If it was put on to the land in its pure state, it burnt the grass, but farmers knew how to manipulate it, and some of them kept storage tanks for the purpose of storing the manure. Another mode was, to take the pails nightly to various depots, where the contents were mixed with ashes in railway trucks and canal barges which were reserved for the purpose. For the refuse, in this form they received from 2*s.* 6*d.* to 3*s.* per ton. If they had a separate system of any kind, they must have ashpits, and there the difficulty arose, because that would entail a great deal of extra expenditure. This character of refuse would have to be destroyed by a destructor, hence the expense. I am not aware that amongst cottage properties we get any ashes mixed with the contents of the pails. I never believed in deep ashpits; I believe in having the ashes at the surface, so that when liquid matter is thrown into the ashpits, the inspector can detect its presence by seeing it oozing through. In cottage properties it is almost impossible to prevent the tenants from throwing in their slops, therefore if any system could be devised to do away with ashpits, I believe, sanitarily speaking, it would be the best thing that could be done. Of course, there is the question of cost to consider. I am not altogether in favour of the pail system. If a closet, suited to any kind of cottage property, could be made to meet the difficulty of the case, I would prefer it. But even the next best system—that was the trough closet—such as Mr. McKie had introduced into Carlisle twenty-five years ago, was liable to disarrangement, for they could not prevent the closets being stopped up, the tenants being in the habit of putting down crinolines and even sheep's heads. At a meeting at Birmingham they gained a great deal of valuable information with regard to the manipulation of excreta, a mode of converting it into "native guano" being shown. Of course, as you know, it is possible to reduce the excreta to a powder. At Birmingham this has only been carried out on a small scale, but I believe the success attending the system so far is sufficient to induce the hope with the Chairman of the Sanitary Committee that the pail contents from the whole town may eventually be dealt with in this way.

The CHAIRMAN : Are any precautions taken in the event of infectious disease being prevalent in disinfecting the refuse sent away in barges and railway trucks ?

Mr. GORDON : I am sorry we have not the arrangement they have at Nottingham. At the meeting at Birmingham I saw the process by which the excreta is reduced to a powder. It is not perfect, but enough was shown to prove that it is possible to carry it out. It is a mistake, however, to suppose that the system is applicable to the whole of a town's refuse.

The CHAIRMAN : What is the cost of the Birmingham system ? Is it not about 60,000*l.* per year ?

Mr. GORDON : I cannot say.

Mr. SPENCER : Wherever a high price is obtained for town refuse as manure, expensive machinery must be erected to carry out the process of converting the night-soil into manure fit for the market. Then there is the cost of removal. Where the population was 200,000, the cost was 20,000*l.* per annum, which is something like 2*s.* per head. At Tynemouth, where the population is 45,000, the cost was 2000*l.*, or 1*s.* per head. I still hold that the mixed system is the best, not only on account of the cost, which is less, but on the more important ground of it being better for the health of the people.

Mr. GORDON : I have very great pleasure in moving that the very best thanks of this Meeting be given to Mr. Spencer for his paper. Our object is to meet and assist each other. We do not meet for mere controversy, but for mutual instruction. There is no more active Member in the Association than Mr. Spencer, who is always to the fore with something for their benefit, therefore he deserves the very best thanks of the Members.

The Chairman seconded the motion, which was carried with acclamation.

TAR MACADAM AND CONCRETE MACADAM PAVEMENT FOR ROADWAYS, AND TAR PAVEMENT AND CEMENT PAVEMENT FOR FOOTWAYS.

By H. U. McKie, Assoc. M. Inst. C.E., City Surveyor, Carlisle.

My first experience in tar pavement was in 1850, when I paved a number of railway platforms in the neighbourhood of Lancaster, on the North-Western Railway. At that time the subject was not so well understood, or so much care taken with it as at the present time. The work was done in the summer months, and the gravel and broken stone used was secured as dry as possible (but not artificially dried, as at present, by stoving, hot flues, or otherwise), it was then mixed with gas tar, as at present (only the tar was not boiled), and frequently turned over for a period of two or three months, afterwards it was laid in layers and the top coat brightened up with spar, procured from the lead mines. The pavement stood fairly well.

The tar pavement for footways, and tar macadam for roadways, was first introduced in Sheffield, and a Mr. Scrimshaw of Sheffield did all this kind of work for me, he and his son doing nothing else, being fully employed in making tar pavement.

On Monday, 30th October, I visited Leicester, and through the kindness of the Borough Engineer (Mr. Gordon), and accompanied by him, I examined the tar macadam roadways and tar paved footways, all of which I found in good working order and answering the purpose for which they were designed; and on November 28th, 1882, Mr. Gordon wrote me with full particulars as to his practice in Leicester in these roadways and footways, as follows:—

Method adopted by Mr. Joseph Gordon, Borough Surveyor, Leicester.

"In reply to your inquiry of the 6th inst., as to cost and other particulars of the tar macadam and tar paving, recently carried out in Leicester, and some of which you saw when here, under the unfavourable circumstances of a heavy downpour of rain, I may say that tar paving had been used to some extent for footways previous to my taking office in Leicester, in March 1881.

"One or two trials on a small scale had also been made with tar macadam for the roadways, which were not considered very successful.

"The footway work, on the other hand, may be said to have proved satisfactory, except some done by the workmen of the borough, which has not proved so durable as was expected.

"Since April last year we have laid down about 16,500 square yards of footway tar paving, and 10,700 square yards of tar macadam for roadways. Up to the month of March last the work was done under contract, but since then it has been done by our own workmen, under the superintendence of Mr. Farthing, the former contractor.

"The method adopted in mixing and laying down the tar paving and macadam is somewhat as follows:—

"The material used is the blast-furnace cinder and limestone. For footways it is sorted by screening and sifting into four different sizes of $1\frac{1}{4}$-inch, $\frac{3}{4}$-inch, $\frac{1}{2}$-inch, and $\frac{1}{4}$-inch gauges, and for roadways to $2\frac{1}{2}$-inch, $1\frac{1}{2}$-inch, and $\frac{3}{4}$-inch gauges.

"The cinder and limestone are both heated on an iron floor under which the flues from the fire run. The material is then mixed in its heated state with a sufficient quantity of a mixture (also in the heated state) of pitch, tar, and creosote, boiled until they form a tough and thick consistency, when it is, after lying for a few days in heaps, ready for use. The quantity of tar, pitch, &c., depends on the qualities of these articles, and particularly of the tar, which varies very frequently. The quantities are also regulated to the character of the traffic expected on the roadway or footway on which the material is to be used, but the average quantities may be taken to be as follows, viz.:—12 gallons of tar, $\frac{1}{2}$ cwt. of pitch, and 2 gallons of creosote to 1 ton of stone.

"The work is laid down in either two or three layers.

"For two-coat footway work, 1-inch material is used, for the bottom layer 1 inch thick, and $\frac{1}{2}$-inch material for the top 1 inch thick, making $2\frac{1}{2}$ inches total thickness.

"In three-coat footway work $1\frac{1}{4}$-inch material is used, $1\frac{1}{2}$ inch thick for the first or bottom layer, $\frac{3}{4}$ inch for the second 1 inch thick, and $\frac{1}{4}$ inch for the top covering $\frac{1}{2}$ inch thick, with the addition of Derbyshire spar sprinkled on the top covering in both cases, to give it a white or variegated appearance, making 3 inches in all. Each layer of material is separately well rolled with hand rollers weighing 13 cwt. each.

"The tar macadam for roadways is laid down in three layers,

the preparation of the material being the same as in the case of footways.

"The first layer is 3 inches thick and of 2½-inch gauge, the second layer is of 1½-inch gauge and 2 inches thick, and the top coat is inch thick of ¾-inch gauge, and covered with cinder dust, each layer being well rolled with a 15-ton steam roller.

"As to the durability of this class of work, I am afraid the experience I have of it, as far as roadways is concerned, is too short to be of much practical value, but I can certainly say that the streets which were done in the spring of 1881, and which you saw, are in excellent condition, and I think I may say that I have every reason to believe that those done this year are an improvement upon our first efforts, and that the life of the roads may be fairly taken at about three years, at the end of which period they will in all probability require topping, that is, hacking over and re-covering with the material used for the top coat, at a cost of from 9*d.* to 1*s.* per square yard. Judging from the wear of one of the largest footway jobs we did last year I am inclined to think that the tar paving for footways will last longer than the roadways, except where the footways are narrow and with large traffic. I would not, however, recommend the tar paving for very narrow footways in main thoroughfares, but it makes an excellent and cheap footpath for side streets, and the outskirts of a town. The cost of our tar paving exclusive of preparing the ground, for three-coat work averages 1*s.* 6½*d.* per square yard, and for two-coat work 11*d.* per square yard, according to the character and extent of the job.

"All our contract work, which was laid in two coats, was done for 1*s.* 3*d.* per square yard, excepting the courts of our Borough Asylum, about three miles out of town, which cost 1*s.* 6*d.* per square yard.

"The tar macadam for roadways cost us 2*s.* 6*d.* and 3*s.* per square yard under contract, also exclusive of the preparation of the ground or special formation, where the latter was necessary, and which was done by a different class of workmen. Since it has been done by our own workmen the cost has been 2*s.* 9*d.* per square yard exclusive of the formation of the ground.

"The cost of the latter varies as a matter of course with the character of the street.

"In old paved streets it only involves the removal of the stones and some few inches of ground, if the foundation be already good, or possibly the carting of a few loads of dry material to make up any apparent soft places in the foundation.

"In other cases it means, where a street is being formed on maiden ground, the formation of a foundation with from 9 inches to 12 inches of what is here called rammel (the refuse of the granite quarries), and the covering of the same with furnace ashes, gravel, or other suitable material to receive the tar macadam. This, with the necessary excavation, adds from 1*s.* 3*d.* to 1*s.* 6*d.* per square yard to the cost, but is requisite even for ordinary macadam roads.

"The cost of preparing the ground, where no such foundation is required, ranges from 3*d.* to 6*d.*, the breaking up of the old macadam roads being the most costly, but to set against this there is the value of the old materials.

"One important feature is the rolling of the foundations before laying down the first layer of the tar macadam; and I may say that I believe that a steam roller is almost absolutely necessary to success with such roadways, although it is probably not requisite to have one so heavy as ours, which is not a little trying sometimes to the gas and water services as well as to the mains themselves. I have no doubt that a 10-ton roller would answer quite as well.

"I hope I have now given you such information as you require, and that you may successfully introduce the tar macadam and tar paving methods into Carlisle, for such streets as they may be best adapted to, for I have no doubt in doing so you will be able to save considerably upon any other method you may have estimated for, excepting the old cobble paving, with which of course it cannot compete.

"Since I wrote you in November last in reference to tar paving and tar macadam, I have been extending the trial of a new material which I believe has never been tried before.

"It is the results of tests, and an endeavour to find a material suited to narrow footways which will wear better than tar paving, and be as near an approach to the rock asphalte as would seem possible by artificial means; it sets just as hard, and is finished with a surface which it would be difficult to distinguish from the latter, and so far it seems likely to wear better and last longer than the ordinary tar paving, while it can be done at less than half the cost of rock asphalte. We had commenced the experiment when you were here in October last, but I am not sure that you saw what was being done.

"The material is prepared from coal tar, Stockholm pitch, and creosote, and run into moulds somewhat similar to rock asphalte.

These again are put into the boilers on the works and re-melted, and then laid down about ¾ inch thick on a 3-inch concrete foundation, precisely in the same manner as in the case of rock asphalte.

"The cost of such a footway is just double that of tar paving, or 2*s.* 6*d.* per square yard. We have laid down about 1000 square yards of it in three different streets as an experiment, and I find on examination, where the footway is only 5 feet wide, and with immense traffic over it, that since it was laid down in October last there is no evidence whatever of its wear. I have, therefore, a very favourable opinion of it, and am going to extend the experiment by laying it down in four other streets with narrow footways."

Tunbridge Wells.

On Wednesday, the 1st November, 1882, I visited Tunbridge Wells, and accompanied by Mr. William Brentnall, the Town Engineer and Surveyor, I examined the tar pavement footways laid down by him, and found them all that could be desired for this class of pavement, and Mr. Brentnall also showed me his macadam roads, which are certainly the best I have seen. This he attributes to careful attention in their formation and the use of the steam roller.

On December 9th, 1882, Mr. Brentnall sent me the following copy of his method of forming tar-paved footways. He had not put down any tar macadam roadways, but was at the time preparing material for making a trial of it over an extensive viaduct he had newly completed. He has also sent me some useful information as to the cost of his macadamised roads, giving details of cost of a good coating of macadam.

Method adopted by Mr. Brentnall, Town Engineer, Tunbridge Wells, for preparing and laying tar pavements:—

"*Materials.*

"Foundation or first course:—

"To be coarse gravel, broken bricks, or other hard coarse materials	1 c. yd.
"Tar made hot	10 galls.

"The stone to be spread out cold and the hot tar added, when by repeated turnings over it shall be thoroughly coated.

"Second course:—

"To be of siftings from the stone breaker. $\frac{5}{8}$-inch mesh passed through the revolving screen attached to the breaker	1	c. yd.
"Hot tar	24	galls.
"Ground lime	$\frac{1}{2}$	bush.
"Water	12	galls.

"The siftings to be made hot and again sifted, to take out all *dust* or *dirt*, then 16 gallons of tar added, and the whole thoroughly mixed by repeated turnings over until the stones are completely coated with tar.

"When the material is required for use, the remainder of the tar (8 gallons) shall be added, and mixed as before; after so mixing, then the lime and water to be added, and passed through a pug or portable mortar mill and immediately carried away and laid *in situ*.

"None of the material to be laid until it has been mixed at least six months.

"Third course is in all respects the same as the second course, except that the siftings must pass through a $\frac{1}{4}$-inch mesh.

"*Description of Workmanship.*

"The ground to be excavated $4\frac{1}{2}$ inches below the kerb or finished surface. Pegs being driven in to give the proper inclination before commencing the works.

"The inclination to be $\frac{3}{8}$ inch to the foot to the kerb or water channel.

"The first course of coarse gravel to be laid 4 inches thick and rolled down to 3 inches thick by a roller weighing at least 7 cwt., a little of the second mixture being laid on to fill up the interstices and render it fit for traffic until the next course is laid.

"After the first course has been laid at least two months (longer the better), the second course shall be laid $2\frac{1}{2}$ inches thick (a sprinkle of No. 3 course being laid on first, and raked evenly), and rammed down with rammers each 9 inches diameter, and weighing 20 lb., and then rolled, and cross rolled to take out waves formed by rolling lengthwise, until a hard, smooth, even, and true surface is obtained. The finished surface to be $\frac{1}{8}$ inch above the kerb.

"Water to be applied with a water-pot in sufficient quantity to prevent the material sticking to the rammers or roller.

"If the first course is made dirty by the traffic before the second course is laid, it should be painted with hot tar, to form a key for the second coat.

"When the paving is dry and hard, and from the summer temperature warm, the surface is to be 'painted' with hot tar as thin as possible and then sprinkled with fine grit.

"A more finished surface is obtained by allowing for, and laying on the fine material of No. 3 course ½ inch thick, and ramming and rolling as for the second course.

"NOTE.—The tar to be always used hot, gently boiling from twenty to thirty minutes.

"Carriage entrances to have 6 inches of macadam mixed as for No. 2 course."

CROYDON.

On Saturday, the 28th October, 1882, I met Mr. Thos. Walker, Borough Engineer and Surveyor of Croydon, and had a long conversation with him on tar macadam, and on November 1st he wrote me on that subject as follows:—

"I have much pleasure in forwarding you the promised description of our method of making tar paving for carriageways. It was laid down nearly two years ago, and although it is in our High Street, most of it has not been repaired since. Previous to this it was Guernsey granite, and usually required repairing annually.

"Tar Macadam.

"The surface of the road was taken off to allow of an 8-inch coat of tar macadam. The bottom 5 inches consisted of the best of the old road material taken off, after it had been sifted, baked, and, while hot, well tarred. With the gas tar a little pitch was mixed, well boiled, and used hot. The stones were turned over until all were well blacked. The material was then taken back to the road, laid on, and well rolled. The top 3 inches were Kentish rag, baked and tarred similarly to the bottom coat, and well rolled with a heavy hand-roller; a day or two afterwards it was well rolled with the 10-ton steam roller. A little fine Kentish rag was used to blind it, having been previously baked and tarred as the other. As nearly as I can remember, the full cost was about 3*s.* 6*d.* per square yard. The old foundation was not disturbed; but if the foundation of a new road and new materials were required, the cost would not be under 4*s.* per yard super."

LIVERPOOL.

On Thursday, November 2nd, I visited Liverpool, and saw Mr. C. Dunscombe, City Engineer, and he kindly sent his assistant round with me to see the streets formed with tar macadam. In

conversation with him, while he admitted that this sort of pavement was suitable for second-class streets, and that he had in Derby put down tar macadam in first-class streets which had answered the purpose fairly well, yet he said nothing but great care would ensure it being always successful, either too much or too little tar and want of care would make the street so treated not a success.

I have since received the following letter from Mr. Dunscombe respecting the tar pavement:—

"I regret that your letter has been overlooked, owing to pressure of parliamentary work, or I should have replied sooner.

"I have received a draft of your report on carriageway and footway pavements, and so far as Derby is concerned, you appear to have full information. I may however state, so far as my experience is concerned, that where the wear is not excessive, I find limestone chippings far preferable to granite chippings for the formation of macadam roads or footpaths. In addition, in many localities it is considerably cheaper, and it takes up a greater proportion of tar than granite. As a rule, when granite is treated in the way it is in Derby, the tar can be readily scraped off the stone, leaving the same perfectly clean.

"I have always indurated the surface with a slight coating of granite chippings, untarred, which I find to answer well.

"With reference to your inquiry as to the extra cost for forming foundations, this is not included in the Derby cost. If such had to be formed on a road with a defective foundation, it would probably be made with 6-inch hand-pitched limestone, which would cost about 2*s.* per superficial yard. This price would include the excavation to the surface of the roadway to foundation level and the hand-pitching, the approximate cost of each being 1*s.* per yard."

Mr. Deacon, the former Engineer and Surveyor of Liverpool, and now the Engineer of Liverpool Waterworks, says in a paper read by him before the Institution of Civil Engineers:—

"This roadway is absolutely impervious to moisture, and wheels and horses make very little noise on it. It is very easily cleaned in Liverpool.

"About 23,000 square yards had been laid in 1879. I consider this form of roadway only suitable for roads having less than 40,000 tons per yard of width per annum, but only consider macadam fit for roads with less than 30,000 tons per yard of width per annum.

"The stones used on top should not be harder than limestone, to ensure even wear.

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"The cost of formation in Liverpool per square yard is as follows:—

		£	s.	d.
0·144 tons of broken stone, including cartage	at 7s. 6d.	0	1	1
0·041 tons of pitch	at 30s.	0	1	3
1·2 gallons of oil	at 2½d.	0	0	3
0·007 tons of coke	at 12s.	0	0	1
Labour	.. ..	0	0	10
Contigencies at 8 per cent.	.. ..	0	0	3
Total cost per square yard		£0	3	9

"Table showing comparative cost of macadam and asphalte macadam in Liverpool in 1879, in street of 40,000 tons per yard width per annum:—

	Macadam. £	s.	d.	Asphalte Macadam. £	s.	d.
Original cost per square yard	0	6	9	0	3	9
Maintenance per square yard per annum ..	0	1	0	0	0	9
Scavenging	0	0	8	0	0	4½

"The stones were screened and watered, the whole turned over, well mixed, and spread to a thickness of from 3 to 5 inches, and allowed to harden, after which a second layer was spread until the required thickness was obtained.

"The cost of repairing this kind of road is more than that of an ordinary road."

Derby.

I wrote to Mr. Thos. Coulthurst, Borough Engineer of Derby, and have received the two following letters from him, with valuable information respecting his practice in tar macadam for roadways, dated November 25th and December 1st, 1882:—

"In reply to your letter of the 20th inst., asking for information respecting the tar carriageway pavement in this town, I beg to state that altogether we have about 12,000 yards of carriageway laid with tar macadam, and so far it is found to answer very well, and it is very much cleaner than the roads laid with metalling in its ordinary state. At the first commencement of using the tar metalling, limestone was used, but as it did not wear very well we changed to granite, which is obtained from the Bardon Hill Quarries, Leicestershire, delivered free at our depot for 7s. per ton, the weight of same being about 22½ cwt. per cubic yard.

"The stone is heated until thoroughly dry and then mixed with sufficient boiling tar to entirely coat over the whole bulk; the tar costs about 2½d. per gallon delivered.

"I have found that the material sets best by allowing it to stand for about a month before use. The first layer of the

macadam is formed of broken granite, $2\frac{1}{4}$ gauge, and spread over the surface an average thickness of 4 inches; this is well rolled, a top coat is then laid on, composed of about $1\frac{1}{2}$ inches in thickness of tarred granite chipping, which is also well rolled, and when the whole surface is made perfectly solid a thin layer of very fine granite chipping is spread over same, after which the road is ready for traffic.

"The cost of executing such work averages about 2*s.* 6*d.* per yard, and in a street where there is only ordinary traffic, it will last for three years without requiring any repairs.

"In our most busy thoroughfares it requires to be renewed every year."

Tar Macadam.

"In reply to your favour of the 27th ult., I beg to say that in March 1879, Mr. Dunscombe laid down a tar macadam carriageway in Sadler Gate, which is a narrow thoroughfare, but one where there is a constant heavy traffic; the total area is about 800 square yards, and the cost was at the rate of 3*s.* per yard.

"The average cost of keeping same in thorough repair for the three years ending March 1882, has been about $4\frac{1}{2}$*d.* per square yard.

"In April this year we entirely top-coated the whole area of 800 yards at a cost of 60*l.*, or at the rate of 1*s.* 6*d.* per yard, and I expect this will stand for twelve months without anything being done to it, and for the next two years after will be maintained for an outlay of $4\frac{1}{2}$*d.* per yard per annum.

"In all cases we use a steam roller which is 15 tons weight.

"We do all our asphalte footways and tar macadam carriageways with our own workmen.

"The footways cost on average about 1*s.* 1*d.* per superficial yard for first-class work.

"I shall be glad to give you any further information if required."

SHEFFIELD.

On the 30th November, I received the following letter from Mr. R. Davidson, C.E., Borough Surveyor of Sheffield, giving his practice in tar macadam:—

"Pressure of business has prevented me answering your letter of the 20th inst. ere this.

"Our macadam consists of best grey furnace cinder hand-broken to pass through a 2-inch gauge, well mixed with boiling tar and

pitch, to be boiled to a proper consistency, so as to spread freely over the stones; there is no particular rule for mixing the two materials as the quality of the pitch and tar varies greatly.

"The macadam should always be laid on in the spring or winter months, as if laid on in the summer the heat of the sun draws the tar out of the pavement, which is very objectionable; the longer the material is mixed before being used the better; we consider the price to be about 2*s*. per square yard, including all labour, carting, rolling, &c., but we can get it done for less money by a contractor, but the work does not nearly stand so well."

The information I have procured gives such full details as to the practice of the different borough surveyors I have written to that I have little further to say on the subject, except that it would in my opinion be a good substitute for macadamised roads, and being impervious to moisture, it would be more healthy and not so objectionable in wet weather by being covered with mud, or in dry weather so dusty. The expense of watering the roadway would be considerably reduced, as well as the expense of scavenging.

Edinburgh.

Concrete Macadam Paved Streets.

On January 3rd, 1883, I visited Edinburgh, and had a long conversation with Mr. Proudfoot, who kindly allowed his chief assistant, Mr. K. Macrae, to go over the streets paved with concrete macadam, and I carefully examined this class of pavement, accompanied by Mr. K. Macrae and Mr. Cunningham's chief assistant, who gave me full information of the mode of the construction of concrete macadam, and Mr. Cunningham's assistant furnished me with a plan of Edinburgh showing the principal streets so paved, marked in red on plan now produced.

The streets paved with concrete macadam were in fair order. The pavement is non-absorbent and could be readily washed quite clean, and the scavenging of such streets is brought to the minimum.

The cement concrete macadam varied from 9 to 12 inches deep. Two modes of forming the streets have been adopted, namely:—

After the street has been excavated to the proper depth and properly formed, and the ground thoroughly beat down, the first coat is laid down with 2-inch macadam, and blinded, and made compact to form required.

The top coat is laid down with clean riddled 2-inch macadam, which is grouted with carefully prepared cement grout, varying in strength from one of cement to three of sharp sand, to one of

cement and one of sand, carefully formed to the proper contour of the street.

The second method is to make a concrete of the broken stone, and cement, sand, and gravel, and lay it on the road in sections in such lengths that each section can be completed before the cement sets. I may state that all broken stones used are of hard metal, whinstone, granite, or porphyry, all hand-broken.

This class of pavement requires great care in construction to make it a success and to prevent unequal settlement in the street after it is completed.

It makes a good street, but as the cost varies from 6*s.* to 9*s.* per square yard it will, I am afraid, be too expensive for Carlisle.

I have received the following letter from Mr. K. Macrae, giving details of some of the streets so formed in Edinburgh.

"I beg to subjoin some details as to concrete macadam streets in Edinburgh.

				Supl. yds.	Cost per Supl. yd. s.	d.
1.	Rose Street Lane, made in	Sept., 1878	area	780	6	6
2.	Valleyfield Street	,, May, 1872	,,	1100	7	0
3.	Gillespie Crescent	,, Nov., 1872	,,	2950	6	0
4.	Glengyle and Leven Terraces	,, Sept., 1872	,,	2680	6	0
5.	Rutland Street	,, Sept., 1873	,,	735	9	0

"Maintenance on 1st, 3rd, and 5th streets *nil.*

"Rutland Street (porphyry metal).

"The area laid in Edinburgh is 18,244 supl. yards, and mileage is 1 mile 302 yards."

The footpath on the south side of Princess Street has been formed of cement concrete, it makes a very good footway, and this class of work can be done for 4*s.* 3*d.* a square yard.

As far as I know cement macadam pavement has not been much used except in Edinburgh.

It is not so suitable for streets that may have to be frequently broken up for gas, water, and sewage trenches. These trench tracks can be fairly well repaired, but it is very expensive opening out a street so formed for pipe tracks, and though it can be made good yet there is always a mark in the street where the pipes have been laid.

Taking the cost of all other things into consideration, I do not recommend concrete macadam for street formation.

With regard to tar macadam for carriageways, and tar macadam for footways, the full consideration of these classes of roadways and footways is, in my opinion, well worthy of your attention.

Cost of Different Kinds of Pavement.

Laid at	Description.	Used for	Cost per square yard.	Extra cost of forming foundations.	Total cost per square yard.	Remarks.
Carlisle ..	Whinstone, 3-in. by 6-in. setts	Roadways	8*s.* 0*d.*	..	8*s.* 0*d.*	Including cost of Foundations.
Do. ..	Do. 4-in. by 4-in. cubes	Do.	6*s.* 8*d.*	..	6*s.* 8*d.*	Do.
Do. ..	Do. chips	Do.	4*s.* 6*d.*	..	4*s.* 6*d.*	Do.
Do. ..	Granite, 3-in. by 6-in. setts..	Do.	10*s.* 7*d.*	..	10*s.* 7*d.*	Do.
Do. ..	Do. 4-in. by 4-in. cubes	Do.	8*s.* 7*d.*	..	8*s.* 7*d.*	Do.
Do. ..	Do. chips	Do.	6*s.* 3*d.*	..	6*s.* 3*d.*	Do.
Do. ..	Caldew cobbles	Do.	3*s.* 4*d.*	..	3*s.* 4*d.*	Do.
Do. ..	Macadam (broken stones) ..	Do.	2*s.* 8*d.*	..	2*s.* 8*d.*	Do.
Leicester ..	Tar macadam..	Do.	2*s.* 6*d.* to 3*s.* 0*d.*	1*s.* 3*d.* to 1*s.* 6*d.*	3*s.* 9*d.* to 4*s.* 6*d.*	
Croydon ..	Do. do.	Do.	3*s.* 0*d.*	1*s.* 0*d.*	4*s.* 0*d.*	
Liverpool ..	Do. do.	Do.	3*s.* 9*d.*	say 1*s.* 6*d.*	5*s.* 3*d.*	
Derby ..	Do. do.	Do.	2*s.* 6*d.* to 3*s.* 0*d.*	1*s.* 4*d.*	3*s.* 10*d.* to 4*s.* 4*d.*	
Sheffield ..	Do. do.	Do.	2*s.* 0*d.*	1*s.* 0*d.*	3*s.* 0*d.*	
Edinburgh	Concrete macadam	Do.	6*s.* 0*d.* to 9*s.* 0*d.*	..	6*s.* 0*d.* to 9*s.* 0*d.*	Including Foundations.
Leicester ..	Tar paving	Footways.	11*d.* to 1*s.* 3*d.*	..	11*d.* to 1*s.* 3*d.*	2 Coats do.
Do. ..	Do. do.	Do.	1*s.* 6½*d.*	..	1*s.* 6½*d.*	3 Coats do.
Derby ..	Do. do.	Do.	1*s.* 1*d.*	4*d.*	1*s.* 5*d.*	
Tunbridge Wells	Tar paving	Do.	2*s.* 0*d.*	..	2*s.* 0*d.*	Including Foundations.
Carlisle ..	3-in. Lazonby flagging	Do.	5*s.* 0*d.*	..	5*s.* 0*d.*	Do.
Edinburgh	Cement concrete	Do.	4*s.* 3*d.*	..	4*s.* 3*d.*	Do.

DISCUSSION.

Mr. Gordon: In my opinion tar paving is all very well in quiet quarters of a large town, and I think it would be very good for a place like Carlisle, where there is not much traffic; but even in such places they would have to avoid its extensive use. The main point which appears to arise from Mr. McKie's paper is the relative advantages, particularly for roadways, of tar paving over local materials. Mr. McKie is now carrying out extensive pavement works in Carlisle, and I find from his table of costs that he is doing the work exceedingly cheap. The chief thing in favour of tar pavements is their noiselessness. In Leicester it was called the "silent macadam." It is softer than even asphalte or wood paving, and has an elasticity about it which gives a certain spring to the roadway. Tar pavement is in great demand in Leicester, in those streets in which doctors, solicitors, architects, &c., reside, and altogether some thousands of yards of it have been laid down. The cost of tar macadam for roadways is from 2*s.* 5*d.* to 3*s.* 0*d.* per square yard. This does not include the cost of making the foundations, but as this only costs about 4*d.* per yard, the cost per square yard may be put down at 3*s.* 4*d.*, including the foundation. Recently a very good artificial asphalte has been produced at a cost of 3*s.* 4*d.* to 3*s.* 6*d.* per yard; the stone used costing 6*s.* a ton. It had just the same appearance as real asphalte, and there seems every probability of its lasting equally as well. The advantages to be claimed for tar macadam are these: it is less noisy, less dusty, and costs less to cleanse it. It is an improved form of macadam roadway, and we must not lose sight of the fact that the cost of repairing is likely to be less than that of ordinary macadam, even on the heaviest roads. I strongly approve of the system of wood paving introduced recently into Norwich, where economy of first cost is important. The borough surveyor there, Mr. Marshall, has had the courage to adopt an entirely new system of wood pavement. He has tried the plan of sawing up ordinary Memel planks into blocks, and placing them like the ordinary paving cubes on a gravel foundation, and he has succeeded in carrying out that work at prices varying from 5*s.* 8*d.* to 7*s.* 7¾*d.* per square yard. During the past few years, over 70,000 yards of this pavement have been put down, and it has been found to answer admirably. I have gone over the city, and I found that the work which had been laid down three years previously did not seem any

worse than that which had been laid down only a year before. In proof of the popularity of the new pavement, I may state that the Norwich Council had petitions in all directions to extend it. I do not think that this Norwich wood pavement is sufficiently known, if it were, we should hear less of the elaborate systems in London and other large towns.

The CHAIRMAN: Is there no bad smell in the parts of the city where this new pavement is laid down? I should fancy that horse-droppings, &c., percolating into the wood, and then evaporating, would have a tendency to cause effluvia.

Mr. GORDON: Mr. Marshall told me that the Corporation had actually saved 1000*l.* a year in the cleansing of the streets, and were much better satisfied than they were before with the way in which the streets were kept. Of course, in Norwich, they adopted the London system of employing boys to sweep up the horse-droppings in the main thoroughfares. Mr. Marshall further informed me that he intended, when the blocks were worn away on one side, to turn them, and so form a new street with the old materials.

Mr. LAWS: We have tried wood-pavement for one or two years in Newcastle, but only on the most expensive plan, and it has answered well, but no cheap system would bear the heavy traffic. I noticed in London that when the blocks were taken up they appeared to be completely knocked to pieces. In Newcastle we tried the experiment of scattering flint pea-gravel on the wood pavement, and found it to answer well. The gravel was at once forced into the wood, protecting the surface, and affording horses a good foot-hold. The same system has been adopted at Nottingham.

Mr. SPENCER: I beg to propose a vote of thanks to the Chairman for his paper. It appears to me that since the time of Macadam very little progress has been made, especially lately, in the improvement of the macadam roadways. This tar macadam, however, seems to be a hopeful improvement, and tar itself is an excellent sanitary agent.

Mr. GORDON: I have great pleasure in seconding the motion. I cannot quite agree with Mr. Spencer in saying little or no progress has been made in road-making since the days of Macadam. I think that with the steam-rollers now in use, we have the means of making macadam roads in a much superior manner. We can now hack up a road, re-coat it, and with the aid of a steam-roller, make it the same day as smooth as before it was broken up.

SETTING OUT THE TRANSVERSE SECTIONS OF STREETS FOR FORMING PAVEMENT.

By H. U. McKIE, Assoc. M. Inst. C.E., City Surveyor, Carlisle.

In order to save time and labour in setting out the contour of transverse sections of streets, and at the same time to ensure a true curve being maintained, the straight-edge described below has been devised.

It consists of a wooden straight-edge 7 inches by 1¼ inches, and about 20 feet long. On this five short vertical offsets slide. One of these is fixed at the zero end and made to slide vertically, the three centre ones slide both vertically and horizontally, the one at the distant end slides only horizontally. On the four vertical offsets which slide vertically are scales marked with divisions which are in the ratio to one another of 100, 65, 35, and 13, being the ratio which offsets from a tangent at the summit or highest point of the curve bear to one another, when they are at equal distances along the curve.

If the rise to the summit of the transverse section is calculated at an inclination of 1 in 36 the largest scale is marked with ⅓ inches, if it is calculated at 1 in 24 it is marked with ½ inches.

The vertical offsets slide so that they can be fixed in any position by the thumb screw as shown in the drawing.

The straight-edge has feet marked on it from the fixed vertical offset at the zero end.

In using the straight-edge first get the difference in height between the channels on opposite sides of the street by putting a temporary peg in the centre of the street at any convenient height, rest the straight-edge on this and level it with an ordinary spirit-level, and when level clamp the longest vertical offset so that it just rests on one of the channels; now turn the whole end for end and level again, keeping the straight-edge resting on the temporary peg and the clamped vertical offset over the other channel, the difference between this bottom of the vertical offset and the channel will be the difference in height between the two channels.

Now if the rise to the summit is calculated at an inclination of 1 in 24 or 1½ inches to a yard, the number of inches of transverse fall will be the number of feet that the summit or highest point

of the street is nearer the high side measuring from the centre of the street. Thus with a difference of 3 inches between the channels of a 30-feet street the summit will be 18 feet from the low channel and 12 feet from the high one.

If the rise to the summit is calculated at an inclination of 1 in 36, or 1 inch to a yard, half the transverse fall in inches will give the number of yards that the summit is nearer the high side, measuring from the centre of the street.

Thus with a fall of 4 inches in a 30-feet street the summit will be 21 feet from the low channel and 9 from the high one.

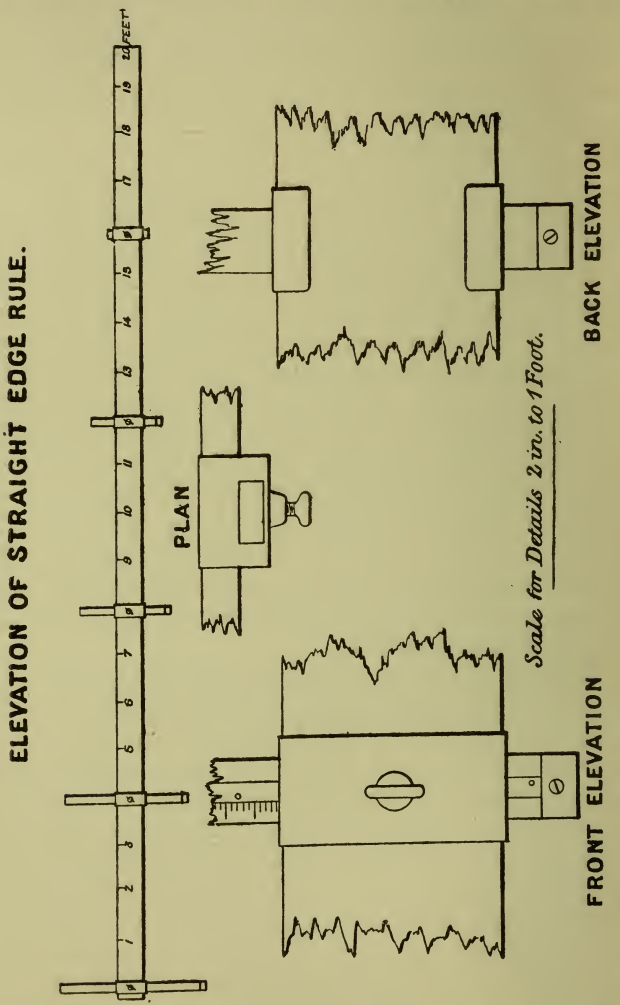
Having found the distance that the summit is from the channels (say 18 feet), clamp the vertical offsets at equal distances apart, the one at the zero end being at the channel, the other at the summit or crown of the street (they will then be at 0, 4 feet 6 inches, 9 feet, 13 feet 6 inches, and 18 feet); while doing this set all the scales on the vertical offsets of 18; now rest the longest or fixed upright on the channel and level the straight-edge, the other vertical offsets will then give points on the curve at their respective places, the last giving the point where the summit is. This done, the same process must be gone through to set out the other side, or 12 feet, the vertical offsets being each clamped at 12, and being at 0, 3, 6, 9, and 12 feet along the straight-edge. If the whole has been done correctly the straight-edge will be level when the longest vertical offset rests on the channel and the shortest on the summit peg already in.

If the street is too wide for the straight-edge to reach from the channel to the summit, find the summit by getting the cross fall between the channels: say it is 40 feet from one channel; now if the board was long enough the vertical offsets would be at 0, 10, 20, 30, and 40 feet, each scale being set at 40; as it is only 20 feet long, set the three longest at 0, 10, and 20, each scale being at 40; now set out the pegs at 10 and 20 feet by levelling the straight-edge with the longest offset on the channel; having done this, replace the longest and second longest offset by the shortest and second shortest, set the scale at 40 and turn the straight-edge end for end, keeping the centre offset on its peg already in, level the straight-edge and put in the other two pegs from the two short offsets, these pegs will then be at 30 and 40 feet from the channel.

By this method any labourer can set out the contour in a few minutes, and it might be adapted to other curves.

The straight-edge rule is in the room, and can be explained to any Member desiring to see how it is worked.

Accompanying this paper you have drawings of the straight-edge rule, and also scales giving points in the curve of the street when set out at an average fall of 1 inch to the yard. These are so



calculated, that in the transverse section of the street seven different points can be marked out in the curve.

The Meeting having adjourned, the Members visited several places of interest in the city, and in the evening dined together at the County Hotel.

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SUPPLEMENTARY MEETINGS IN LANCASHIRE AND CHESHIRE DISTRICT.

MANY Members having thought the usefulness of the Association might be increased by occasional visits to works in progress and objects of professional interest, an attempt has been made to arrange a series of Supplementary Meetings; the first was held at Denton, near Manchester, on 20th October, when, owing to the short notice and unfavourable weather, very few Members attended; the second meeting at Liverpool, on 10th November, was more successful, and was attended by nearly fifty Members.

DENTON MEETING.

This visit was to the new reservoirs at Denton in course of construction by the Manchester Corporation. The water supply of Manchester is derived from a drainage area of 19,000 statute acres of ground near the Woodhead Tunnel on the M. S. & L. Ry. between Manchester and Sheffield. The water is stored in thirteen large reservoirs, having a total capacity of 4544 million gallons, and the new Denton reservoirs are intended to further increase this enormous storage by 1442 million gallons.

			gallons.
No. 1	80 acres	27·6 deep	528,000,000
No. 2	69 „	22·6 „	371,000,000
No. 3	102 „	22·6 „	543,000,000
			1,442,000,000

The ground on which the reservoirs are built has proved very treacherous in some places, and necessitated embankments with a slope of 4 to 1 and a base of 300 feet; the puddle walls are about 8 feet wide at top, and 12 feet at bottom; and the depth of the puddle trench varies from about 8 feet to 30 feet.

The water on leaving these reservoirs is strained through a

copper wire strainer, 30 strands to the inch, and weighing 8 oz. to the square foot; the water being clear and pure is not filtered.

The level of the Denton reservoirs is about 200 feet above the Manchester Exchange, and the daily supply amounts to about 20 million gallons.

LIVERPOOL MEETING.

The Members first visited the Mersey Railway Tunnel, now being constructed between Liverpool and Birkenhead from the designs of Messrs. Brunlees and Fox.

The tunnel is about one mile in length, and is constructed in the red sandstone rock, which extends under the entire width of the Mersey. A great portion of the work has been performed by Colonel Beaumont's boring machine, by means of which an advance of as much as 100 feet was made in a single week.

SECTION OF THE MERSEY TUNNEL.

DIMENSIONS.

	Length.	Width.	Height.
Main tunnel B to B′	1230 yds.	26 ft.	20 ft.
Drainage headings C to E and C′ to E′	340 yds.	7 ft.	7 ft.
Central plateau of main tunnel, E to E′, almost level, but draining both ways to the drainage headings	550 yds.		

The shafts are 90 ft. to the level of the rails A to B, and A′ to B′, and 160 ft. to the sumps C and C′ whence the water is pumped up.

The tunnel is lined with six rings of Staffordshire blue bricks, set in cement. It is designed for the passage of two ordinary trains, and is 26 feet wide and 20 feet high. The top of the tunnel will be about 30 feet below the bed of the river in the centre.

During the construction of the tunnel 6000 gallons of water per minute have been pumped from the works; this water was conducted to the pumps at the ends of the tunnel by a heading driven under the tunnel, and into which the water flowed at frequent

intervals, so as to keep the work in the tunnel dry during its construction.

The water pumped from the headings was quite fresh, showing that the river water did not get into the heading; and it was noticed that the rock yielded less water in the centre of the river, where the thickness was least, than at the sides with a greater thickness of rock.

The work proceeded simultaneously at both ends of the tunnel, and the two headings met in January 1884.

The Members were next conducted by the City Engineer to the pier head covered way, now in course of erection, and afterwards to the tramway works, where examples of the rails laid in combination with stone, asphalte, and wood pavements of various kinds were examined with much interest.

The Liverpool system of tramways is a combination of cast-iron sleepers and steel rail, the whole laid upon a bed of concrete. The greatest care is taken with every part of the work, and no expense is spared to ensure thoroughly good work, and to secure a regular, close, and perfect joint between the rail and the paving.

The tramways are constructed by the Corporation, and leased to the Liverpool tramways.

A central groove is adopted in Liverpool, but the system of construction is equally adapted for the ordinary grooved rail.

DISTRICT MEETING AT SOUTH SHIELDS,

February 16, 1884.

Held at the Town Hall, South Shields,

Mr. Matthew Hall, *Borough Surveyor, South Shields, in the Chair.*

NOTES ON THE PLANNING AND CONSTRUCTION OF HOSPITALS FOR INFECTIOUS DISEASES.

By A. CAMPBELL MUNRO, M.B., D.Sc., Medical Officer of Health, South Shields.

Having in the past two years devoted a good deal of time and trouble to the organisation and equipment of a new hospital for infectious diseases in this town, and being connected with another Corporation which has for some time been considering the question of a prospective hospital of that sort, it occurred to me, when asked to contribute a paper to the 'Proceedings' of the Association, that a few remarks from me on such a subject might be of a little interest to the Members; while the actual hospital here, which you will have seen, will form a practical application of a practical commentary upon my remarks.

One of the first matters to be considered when a new hospital for infectious diseases is being talked about is—for how many patients ought accommodation to be provided? And a general formula has come into vogue which sets forth that accommodation should be provided at the rate of one bed for every two thousand inhabitants! This is a most fallacious method, for the amount of isolation accommodation necessary depends not nearly so much on the number as on the general character of the population. I

believe firmly, for instance, that as much hospital accommodation should be provided in Jarrow (with its population of 29,000) as in South Shields (with its population of 63,000), for in Jarrow the large mass of the population is of the class which, inhabiting one- and two-roomed houses, cannot possibly provide for the isolation at home for cases of infectious disease—the isolation accommodation must therefore be provided in hospital; then, the population, consisting almost entirely of this class, is much more liable to epidemics, and they spread more easily. Further, the population is a very fluctuating one, and new comers are apt to bring the seeds of disease with them. And finally, a town population with a large Irish element in it is always found to be subject in an exceptional degree to epidemic diseases. It is thus evident that population alone is an insufficient basis on which to calculate the needs of a district in the way of hospital accommodation.

Next comes the question of site. It is desirable that this should be in the immediate vicinity of the town for whose benefit it is intended, as less difficulty is then experienced in persuading patients and their relations to consent to removal to hospital. A sufficient amount of ground should be secured to permit of free exercise for the patients, to permit of the future extension of the building if necessary, and to prevent all fear of aerial carriage of infection to adjacent houses—though that is a mode of infection about which I am very sceptical. The site should be moderately elevated—preferably on a slope—our hospital catches too much wind. The ward-blocks should face preferably south-east and north-west. The soil should be dry and well drained, and free from animal or vegetable deposit, of course. Indeed, a layer of concrete under the buildings, with free ventilation under the floors is desirable—or, better still, the wards might be built on arches.

The buildings will necessarily consist of an Administrative block, one or more Ward-blocks, and the necessary out-houses.

1. *The Administrative Block* should at first be built larger than is necessary, so as still to be sufficient in the case of future ward extensions. Its elaboration will depend entirely upon the scale on which the hospital is being constructed. But in any case in it should be contained the sleeping accommodation for all the staff—nurses should never, for various reasons, have their bedrooms in the ward blocks.

2. *The Ward-Blocks* must each contain two wards, male and female: the female ward should generally be the largest, as in it

children—male or female—will afterwards be placed. It is much more convenient to have a large number of small wards, than a smaller number of large wards with the same number of beds. Thus in an eight-bed ward—one single case of smallpox will usurp all the accommodation provided for eight; indeed it would not be proper theoretically to treat any other infectious disease in the same ward block. The lack of small wards is our main difficulty at the Denes Hospital. The ward-blocks must be separated from the administrative block by corridors more or less open—so as to be cut off atmospherically from it. Our corridors at the Denes Hospital are rather too exposed—the cross ventilation being sufficient to blow away the patients' dinners *in transitu*. The sides should be protected by louvred woodwork, with sufficient window lights. Or a plan which I have seen suggested might be adopted—that of a central partition along the corridor, on the lee side of which the nurses would walk. The ground-plan for a ward-block which I would suggest would contain two wards with an intermediate nurses' room with glazed opening on either side into the wards, this room being also arranged as a ward kitchen, and having a press in it for dietetic stores. The entrance to the block from the connecting corridor would be opposite the nurses' room, and would have a small room on either side of it—one, in which there should be a small fire-place, would be the linen and bedding store for the block, fitted up with strap-shelves and having a press in it; the other small room being for the reception of a movable bath, with water taps and waste pipes for its supply and discharge. The patients' entrance in the ward block would be into the corridor at the end next the ward block. The wards would have a capacity of 2000 cubic feet for each bed, 144 square feet of floor space; any air space above 14 feet from the floor is thrown away. The wards should be well lighted by windows on opposite sides, but it has been found that where the proportion of window surface is materially over 1 square foot for each 70 cubic feet of space, it is very difficult to maintain a sufficient temperature. The sills of the windows should certainly not be more than 3 feet from the floor, and I would prefer them lower; and the windows if intended to aid in the ventilation of the wards should rise to within 6 inches of the ceiling. For the efficient ventilation of the wards the arrangement I would suggest is that there should be ventilators in the walls under the level of the beds, closable by sliding doors; while near the roof I would have interposed between the windows Sherringham

valve ventilators. The warming and gas-lighting should also be made to subserve the ventilation of the wards; this is well carried out by means of Benham's ventilating stoves as in use at our hospital, in which an incoming current of pure air is warmed before being delivered into the rooms, while the foul air is sucked off at the level of the ceiling around the funnel of the stove. Further, there ought to be star-light gas-burners in the ceiling with exit tubes over them, and the gas-pipe to these ought to be separated from the side-wall lights (of which there ought to be one to each bed), so that the star-lights may be left burning at night out of the reach of delirious patients or children. There ought to project over each side-light an exit tube for the escape of the products of combustion of the gas.

The ward-blocks ought of course to be only one story high—this is generally recommended on the score of the contamination of the air supplied to the upper wards when under ones exist; I recommend it on the score of diminished labour to the nurses in the avoidance of stairs to climb—a very material matter in hospitals of the size of ours, in which the same nurse has to do duty in more than one block. Each block should—to afford a sufficient circulation of air—be separated from the next by a space equal to once and a half its height, or, where the blocks are of unequal height, by a space at least equal to the height of the highest. Each ward should have the end next the door separated by a light wooden screen from the rest of the ward, and should be furnished as a sitting-room and dining-room for convalescent patients, whose amusements are apt to interfere with the comfort, and whose dietary is apt to excite the envy of patients still seriously ill, when they occupy a ward in common. The floor should be of narrow pitch-pine boards—polished, to do away with the damp atmosphere arising from frequently washed floors. The walls should be lined with some denser, less porous material, than ordinary plaster. In the ward woodwork, all ledges likely to retain dust should be abolished — the window-sills should slope and not form level ledges.

At the further end of each ward block, and cut off by a short lobby with cross ventilation, by means of fixed louvred openings, the water-closet, ward sink, and lavatory would be placed.

In connection with each hospital for infectious diseases there should be a small probationary block for the reception of cases of a doubtful nature. This block might also be utilised for the

reception of better-class patients, and for this purpose should have at least two patients' rooms, with a nurses' room attached to each.

At the most remote corner of the grounds, and under one roof, might be placed, as in the Denes Hospital, the *post-mortem* room and ambulance shed. In another detached building would be the disinfecting chamber. A third out-building would be arranged as a laundry, with tanks for washing infected linen, &c.

I have thus run over in a hasty fashion some points which have occurred to me as worthy of note in connection with the planning of hospitals for infectious disease. For the scrappy nature of my communication, I have only to plead that too common excuse now-adays—want of time.

DISCUSSION.

Mr. Laws: We should be very much obliged to Dr. Munro for his interesting and valuable paper. On several points our views are identical. The subject is of some interest to me, as it is proposed to erect a similar hospital for Newcastle, which, being a larger place, and having perhaps more to contend with, is slower to move, and content to follow the example set by a smaller but energetic authority. I am glad that I agree with Dr. Munro on so many points, such as small ward-blocks, window spaces, &c. But I am not certain that the method of dividing the blocks by open corridors is the safest. With regard to the heating of hospitals, one of the most successful methods, I am told, is by running small steam pipes round the whole ward, so that you can regulate the temperature very well indeed. With regard to the floors of the wards, in a small temporary hospital we have tried a method which has been found successful. After the boards are laid and well dried, we rub in paraffin wax, which fills up the crevices, and the floors are much more readily cleansed than if the boards were left bare. With respect to the walls, I have very little to say, and scarcely know what to recommend, but I believe that Parian cement is as good as anything that can be put on, as it leaves no joints, harbours no dust, and is moderate in price.

Mr. Bower: I should like to know on what area of ground the hospital stands? An important question now under discussion at Gateshead, is that of the necessity of a gate-lodge to hospitals of this class. As to the management of this hospital, the details

placed before us seem to be tolerably perfect. I should advise a gate-lodge at the entrance of every hospital, in which visitors can wait when inquiring after patients. I shall be glad to know if you have had any experience in that way, and, if so, with what result?

The CHAIRMAN: We have two acres of land on which the hospital is built. With respect to the corridors, in the original plans they were shown partly closed with glass, but the Local Government Board insisted upon their being entirely open.

Mr. JAMES HALL: I have been instructed to prepares ketch-plans for a hospital for Stockton, and therefore it gives me additional pleasure to hear the paper read by Dr. Munro. I would like to ask one question, whether glazed bricks or glazed tiles let into the walls would not be preferable to the Parian cement mentioned by Mr. Laws, and be easier cleansed?

Dr. MUNRO: As to the corridors, there is some difficulty in carrying the food to the wards on windy days, but the Local Government Board is properly jealous of limiting the ventilation of hospitals. I have no doubt, however, they would sanction some screen being arranged along the centre of the corridors, as a protection from the force of the wind. It would be desirable to have an entrance lodge, and that all inquiries should be limited to this lodge. In very large hospitals it would be an advantage to have a gate-keeper, who might also be useful in other ways. With regard to glazed bricks, in the first place they look exceedingly cold and comfortless, and, further, there would necessarily be crevices and cracks, which would tend to harbour dust and infectious matter. In the hospital here I believe the material is selenitic, which is of a tolerably dense nature, and will probably do as well as anything else, if it be lime-washed year by year, and so all infection in the walls destroyed. There should be not more than one square foot of window surface for each 70 cubic feet. I thank you for the very kind way in which you have received the paper.

RECENT STREET IMPROVEMENTS IN SOUTH SHIELDS.

By MATTHEW HALL, Borough Surveyor, South Shields.

The Corporation of South Shields has just completed an excellent improvement at the Mill Dam, by building a wall across the dam and filling it up with the excavations taken from the Commercial Road improvement. A large open space has thus been formed. The old, unsightly, and insanitary public conveniences have been swept away, and modern ones erected near the edge of the quay, far removed from any dwelling houses, and of a less obtrusive character. By an arrangement with the Tyne Plate Glass Company, the Corporation has built them a boundary wall with cement concrete, faced into ashlar blocks, and finished with a bold moulded coping. The Company permitted a corner of their yard to be taken away to give the wall a good bold sweep towards the river, and this has the effect of leading all the traffic from the market place and ferry gradually and easily towards the Custom House buildings and public quays. A good wide Caithness flag footpath has been laid alongside of the wall. The large open space has been block paved, care being taken to considerably improve the levels, thereby making not only the approach to the quay, but also to the Holborns and Commercial Road, very much easier for vehicular traffic. The open space (which is lighted at night with one of Suggs's patent 100-candle power lamps) will be of great advantage to the seamen and others frequenting the Shipping Office, and forms for them a good promenade while waiting to be engaged. In addition to being a great street improvement, it must necessarily be a great sanitary improvement to the whole locality, as it now forms a good wide opening direct from the river, in one of its widest parts, sending, as it were, the sea breezes direct into that part of the town. The contractors for the walls, filling up of the dam, and erecting the new conveniences, &c., were Messrs. Todd and Marshall; for the paving, Messrs. Wilson and Walton, and for the

flagging, Mr. Henry Gillespie, all of whom have executed the work in a very satisfactory manner.

The Commercial Road improvement is probably one of the best street improvements effected by the Corporation during the last ten years. Commercial Road, from the Mill Dam to Cone Street, was formerly a dirty, narrow road, and very steep, so hilly indeed as to be shunned not only by the owners of vehicles, but by pedestrians, the result being that most of the traffic to Tyne Dock, &c., went round by Green Street and Laygate Lane. To remedy this state of things, the Corporation decided to go in for an extensive improvement, and bought a slice of land and houses on the east side from the North-Eastern Railway Company, two houses on the west side, and also a piece of land forming the hill side at the foot of the road. The houses, &c., were pulled down, and the new retaining walls on either side of the road have been built with cement concrete. Owing to the great height of the new walls, and the weight of the hills behind them, with the houses within a few feet of the new walls, the latter had to be very substantial, and great care exercised in their construction. The walls being built, the excavations were proceeded with, and 12 feet in depth was taken from the crown of the old road, the excavated material being used for the filling in of the Mill Dam, closely adjoining, thus effecting a great saving in both contracts by doing them at the same time. After the excavations were completed, the walls were plastered with cement, and formed into ashlar blocks, surmounted with a bold moulded coping. Three roomy stores were built on the west side, on the site of the two houses taken down. By lowering the road, as described, the gradient has been improved from 1 in 8 and 1 in 12, as before, to 1 in 20 and 1 in 60 as now, and it has been widened an average width throughout of about 15 feet. The road is thoroughly well lighted with improved 10 feet per hour lamps. The contractors for this work also are Messrs. Todd and Marshall, who have executed their contracts in a very satisfactory manner, under my direction. Both the Mill Dam and Commercial Road improvements secured the sanction of the Local Government Board, who authorised the Corporation to borrow 5600*l.* for their execution, but the works have been done for considerably less.

It will, perhaps, be of interest to give some few particulars of the work done.

There were 7347 cubic yards of excavation, 2125 cubic yards of concrete walling, and 1740 superficial yards of cement plastering.

The cement was from the works of the Union Co., at Wallsend-on-Tyne, and 348 tons were used in the work. The proportions used in building the walls, were five of gravel from the adjacent Ballast Hill, to one of cement, and for the plastering two of sharp sand to one of cement.

Station Road Improvements.—This road is a very important one, there being an immense traffic over it (being the main road between high and low Shields), it was until recently macadamised, and owing to its narrowness was constantly in a more or less wretched condition, and very costly to maintain; last year it was considerably widened by purchasing a slice off the Ballast Hill belonging to the North-Eastern Railway Co. New retaining walls were built with cement concrete similar in every respect to those in Commercial Road, Mr. Robert Atkin being the contractor. Good wide Caithness flag footpaths have been made, and the whole of the carriageway paved with Aberdeen granite setts on a lime concrete foundation. The total cost of this improvements has been 2140*l.*

In concluding this paper, I think I may safely say that the action of the South Shields Town Council in carrying out those improvements has received the warm approval of every rate-payer in the borough.

Votes of thanks were severally accorded to the Mayor for placing the Town Hall at the disposal of the Association, and to the authors of the papers for their valuable and interesting contributions. After partaking of luncheon, kindly provided by Mr. Hall and Dr. Munro, the Members, under their guidance, visited the extensive street improvements recently executed, the Borough Hospital, and the Tramway and Corporation Stables. After leaving the stables the company proceeded by special train from Westoe Lane, on the Whitburn Coal Company's railway, to their quarries at Marsden, which were inspected under the direction of the officials. Dinner was then served at the Marsden Inn. The company afterwards returned by special train to South Shields, having spent a pleasant and profitable day.

DISTRICT MEETING AT BRIGHTON,

March 15, 1884.

Held at the Town Hall, Hove,

Mr. W. H. White, *President, in the Chair.*

The minutes of the last meeting held in the Home Counties District having been read, confirmed, and signed, Mr. Ellice-Clark tendered his resignation of the position of Honorary District Secretary, which was accepted with regret, and a cordial vote of thanks was accorded to him for the valuable services he had rendered to the Association. Mr. O. C. Robson, Surveyor to the Local Board, Willesden, was then elected to fill the office.

THE SUPERVISION OF PRIVATE BUILDING BY PUBLIC AUTHORITY.

By E. B. ELLICE-CLARK, Memb. Inst. C.E.

Preliminary.

Repugnant as is to the English people the interference of the State with private enterprise, it has now become a recognised necessity in respect to human habitations. Like all changes in the principles of government, this has come upon us slowly; and even now, while the State control over buildings is one of the pressing necessities of the age, it is resented so stoutly, that the Legislature has environed controlling laws with such fences as to impede very largely the action of the executive. It has cast the burden of making and administering the controlling laws upon parochial authorities, and thus provides a buffer between the controlled and the real controllers.

It is now too late to discuss the question of the interference or non-interference of the State. The principle being admitted, there remains only the question of the degree of State interference, and

how should that interference be regulated. In former times it was regulated by custom. The desire to follow custom is still so strong in the minds of the executive, that nearly every district in the country has custom bound up in its local laws, often in direct defiance of modern requirements, and when the contrary has proved to demonstration to be the philosophical as well as practical conclusion.

Some one with that love of custom strongly imbedded within him may explain one of the most prominent cases of a purely physical condition differing so widely as does the thickness of a wall. Why a wall has a statutory minimum thickness of 9 inches in Oldham and half this thickness in Manchester? In the pursuit of this subject, the author has communicated with every local authority in Lancashire and Cheshire, upwards of 170 in number. And while there is a similarity between their laws, each and every one of them bears the stamp of individuality. How can the conditions under which man and property live and exist, possibly vary so much as to produce 170 different sets of laws on the same subjects in two adjacent counties? In what language should we speak if there were but two different laws regulating the hours of labour for children in Manchester and Oldham? Yet the effect of thin walls and premature unfitness for work is alike insanitary, and upon no other ground has the State a right to interfere with either beyond a certain point.

Yet custom has such a strong hold upon the inhabitants of one county as to insist upon a physical requirement being made twice as stringent in one town as in another only a few miles distant. It will be seen at a glance if the elemental requirements of a building form the subject of a wide diversion in practice in proximate towns, what difficulties the State has to contend with when dealing with the more complicated conditions required to complete a house before it is theoretically and practically fit for human habitation.

A question which naturally arises in the mind of the political economist is, "How far is the State justified in controlling the individual action of a builder?" This has been answered in such a variety of ways as to bewilder the highest authorities on the subject. The effect of those answers is seen in the chaos of laws governing the builder's action. In the great city of Manchester this question is answered in a tract of seven pages, while in a rural parish in Sussex the answer requires 60 pages of closely printed matter.

This bewildering state of things carries us back to the primary question, What are the objects sought by the State in controlling the erection of buildings? and if these objects are pursued to their consummation, What is it necessary for the State to control?

Of those burdens which come within the scope of the demands of the State upon a private citizen, only a small number have been dealt with by the Legislature in a direct manner by public statute, though the majority have formed the subject of Local Acts of Parliament.

Before proceeding to details it is well to discuss the general effect of the State interference upon the prerogatives of persons and property.

The descent of the State from the domain of Imperial and general questions to the region of domestic and detailed governance has always been deprecated in this country, as being liable to undermine that self-reliance, begotten of individual responsibility, that is the characteristic of our people. There may be a negative danger in this, but the "free trade" principle is a positive danger, which, in this highly civilised and densely populated country, has intensified to such a degree as to call loudly for State interference. It should be borne in mind that this is, after all, the co-operation of a higher authority.

It may be denied that in many particular instances the supervision of private building by public authority proves so; as, for instance, the subjection of plans for a building prepared by an eminent architect to a retired butcher, who may be appointed surveyor to a local authority, an instance within the experience of the author. This, after all, is a personal matter which does not affect the principle of State control: it is an incident in the administration of the law that only requires time to amend. The law being written and construed correctly by the architect, he may put on one side the official, whose functions are really ministerial; nor has the architect, however eminent, any cause for personal or professional annoyance, if the law is the State law, applicable to the entire country: a duke might as well quarrel with the custom-house officer who searches his grace's trunks for contraband goods.

The objection that the supervision by the State will undermine self-reliance, and strikes at the liberty of the subject, is a bogey that might frighten a people like the Italians, who have just cast off a despotic government, but is a shallow artifice in England.

Liberty in building has had so free a range as to become a danger

to the State, therefore its subjection to detail legal supervision has become a paramount State necessity.

There is always a cry of danger raised when the State proposes to legislate for particular trades, or particular classes of the people, whereby their particular trade or class are affected by special legislation in a different manner to the majority of the people, but all such cries and objections on the part of the particular classes should be scrutinised with great care: the affected ones are so deeply interested in the *status quo*, that their judgment becomes warped, however honest may be their intentions, and the demands of the majority of the people should be taken in preference to that of a small interested minority.

The great difficulty is—How far should the State interfere, so as to control the moral habits and physical health of the people?

It appears to the author that there is no halting place, when the proposition of the necessity of State control is granted. It is desirable that the control should be searching and thorough. Uniformity and impartial execution are absolutely essential to the successful administration of all laws. Nor, on the other hand, should any law be greatly in advance of the people's intelligence; for although it may be a truism, "That law can never attempt to forbid all that is morally wrong, yet that gets to be morally wrong which the law forbids;"—the execution of any laws much in advance of a people's intelligence cannot be administered without coercion, and coercion is impossible under a system of local government. Therefore, if laws regulating building are made too stringent, and far in advance of the people's knowledge of them, they will at first excite resistance, which, from the very nature of local government, must be successful, then fall into desuetude, and finally into contempt. The whole object of the State will thus be neutralised.

Again, the effect of excellent building regulations may be nullified by reason of the want of intelligence on the part of the executive.

This is notoriously the case in the administration of the Model Bye-laws, where urban communities are governed by rural authorities. Here we find a detailed complicated code, affecting landed property adjacent to towns to a greater extent than Imperial taxation, placed in the hand of an executive so ignorant that the spectacle would be laughable were it not too serious for frivolity. It is hardly necessary to cite cases which must be numerous

in every district in the country, but, as an executive officer, the author's opinion on the subject may receive more attention than those outside the charmed circle of the local surveyor.

The —— Union is the local authority over an area of 47,471 acres, with a population of 49,078, which includes several considerable towns and the parishes immediately contiguous to a town of 120,000 inhabitants. The extension of this town has passed into the area of the Union authority. Cottage building is progressing in the *rus in urbe* area at a rapid rate. The Board have adopted the Model Bye-laws. The executive officer formerly occupied the respectable position of a master butcher. In addition to his office of surveyor, he is inspector of nuisances—his salary is 150*l.* per annum. What is the result of this great anomaly, of the adoption of exceptionally stringent detailed building regulations by an administrative department of the local legislature, and the appointment of an absolutely incompetent, technically ignorant, ill-paid person to carry them into effect? Not resistance, but desuetude and contempt—not only are the structural requirements of the bye-laws set on one side, but neither plans nor notices are sent to the authority for consideration. Such a state of things, while it calls for the immediate attention of the Imperial Legislature, shows the absurdity of enacting laws without providing proper machinery for their administration.

This opens the very large question as to the executive, and one which must be dealt with by Imperial Parliament at no distant date.

It is, however, generally conceded that the executive officers in *towns* are men of sufficient intelligence to administer the laws. Trained engineers and surveyors are fast filling the appointments formerly held by men of inferior technical knowledge, and it may be taken for granted generally, that though the executive staff in towns is insufficient, it does not lack want of intelligence and experience.

The extent to which the consummation of State interference in private building goes may be seen from Tables A, B, and C.

Although it is improbable that either statute or bye-laws will for many years be so far-reaching as to include all the subjects embodied in the tables, still it is essential that the leading ones should be dealt with if State interference is to have any utility.

Table E.

Showing what might be embraced in a General Act of Parliament.

Documentary Deposits—Plans and Notices.

New Streets and Sewers.—Gradients and levels.
Direction.
Width.
Construction.
Height of curb or datum stones.
Duration of certificates approving plans.
Entrances to streets.
Intersecting streets.
Foot and roadways (respective areas).
Width of streets in relation to height of buildings.

New Buildings.—Sites to be free from impure deposits.
Line of frontage; houses to be set back or brought forward.
Size and strength of materials—
for walls.
„ floors.
„ roofs.
Quality of mortar.
Foundations.
Damp courses.
Separations of buildings by parti-walls—definition of parti-walls.
Flues and fireplaces.
Impermeability of roofs and walls.
Precautions against fire — including egress from public buildings.
Minimum height of living rooms. Windows in ditto—ventilation of ditto.
Situation and number of privies and
Water-closets and ashpits.
Accommodation in factories and workshops.
Plumbing.
} Drainage of Houses.
Air spaces around buildings.
Height of buildings in relation to street-width.
Projections over highways.

Legal Proceedings—Notices to officials.
Inspection by officials.
Method of proceeding.

What is General and what Local?

In deciding what laws should be general and what local, there are some requirements that have passed out of the region of opinion, or have been decided by such overwhelming majorities that they should be accepted by the Legislature.

In addition to the requirements of the Public Health Act of 1875, those enumerated on Table E are such as in the opinion of the author may readily be included in Statute Law.

A glance at Tables A, B, and C will show that some of the State requirements are *local*, such as could not be dealt with satisfactorily by Statute Law, and a greater number *general*, on which statute laws could be framed applicable to the entire country.

It is more than desirable, it is essential that the laws should be uniform, therefore no variation should exist, except when it is absolutely necessary.

The structure of laws for regulating buildings has been formed upon the assumption that they should be local and permissive.

Experience is demonstrating that the inverse order is the more correct. If we work from the basis that all laws should be general and obligatory, we should discover that, as a rule, local requirements would differ in degree only. Such difference may be classed under the heads of

Physical.

Climatic.

Occupation of inhabitants.

Whatever theoretical disadvantages a general Act of Parliament might possess, it would, at all events, do away with the scandal of such exceptional legislation as exists in Birmingham, where every proprietor of land except Lord Calthorpe is compelled to make carriageway streets 50 feet wide—the Edgbaston estate of this nobleman being exempt from the provisions of the Bye-laws.

A very singular piece of legislation in Birmingham is also observable, in the fact that no provision is made for sufficiency of air space to houses above 20*l.* annual rateable value.

Documentary requirements.

The first requirement of the public authority is proper documents, permanently deposited, to enable them to determine—

(1) The intentions of the applicant.

(2) To preserve a record in case of dispute.

What documents the State should be provided with, previous to the execution of any works, has given rise to much discussion. So far as the author's information extends, with the exception of Chester, where there are no building regulations in force, and the metropolis, where plans are not required to be deposited for ordinary buildings, Liverpool, Manchester, and Salford are the only cities of magnitude in the country where complete plans are not required to be deposited with the authorities.

Clearly it would appear necessary for the State to be in possession of such documents as will enable it to ascertain whether or not the requirements of the law are to be complied with.

As a mere matter of economy, the builder, having his plans approved, knows precisely what he can do, and what he cannot. Mere written description is insufficient to determine this, just as a specification and elevation drawing would be insufficient for the erection of a house, when the design is prepared by any one other than the builder.

Without plans and sections of every floor the supervising official cannot be made aware of the builder's intentions. The latter may begin to erect houses, intending them to go up four floors, while the width of the street will only allow three floors, the former necessitating thicker walls; having got up three floors, he will be told he cannot be allowed to go higher.

The same argument applies to the thickness of walls. A builder may begin with walls of sufficient thickness to comply with the law for street widths, and proceed to build beyond the height and length prescribed for the thickness he is building. The local authority cannot give him notice to build walls of the statutory thickness at the proper time, but only prevent his building to a greater height and length than the thickness of the lower wall permits.

With such information as a plan and section of every floor, the local authority can give the builder notice immediately he begins his work; time, trouble, and expense would thus be saved.

Plans deposited in the hands of the local authority are valuable for reference. The author has repeatedly permitted tracings of house plans to be made from the deposited plans, the originals being lost, and the architect may have migrated, taking his plans with him.

It must be conceded, that it would be an advantageous thing if the plans of every house in Liverpool could be seen at the City Engineer's office.

Who are the objectors, and what are the objections to the deposit of plans? The objectors are architects; their avowed objection being that inasmuch as plans are their private property, when they submit them to a public official they become public property, and their ideas may be stolen. In other words, that by parting with copies of their plans, they are parting with a commodity which to them is their capital, and that the State does not call upon any other profession to do this without compensation. Secondly, the cost of preparing plans is an additional charge upon the proprietor.

The ground upon which the first argument is built has been cut from beneath the feet of the objectors themselves, who voluntarily, greatly to the honour and the advancement of their profession, have for many years past supplied the public, not with mere plans and sections, but in addition with every detail, both constructional and ornamental, necessary to carry a building to its completion.

It would be impossible to name one class of building in existence for which plans could not be found in the professional journals, in which for a few shillings a year both the town surveyor and the architectural student may find enough and to spare for all purposes of copying and instruction, far beyond what could be obtained by plans deposited with the State. It appears to the author, that by resisting the demands for plans, architects are limiting, to an unknown extent, the legitimate work of their profession. He is quite unacquainted with the lucrativeness or otherwise of the profession; but it is a self-evident proposition, that if an architect were employed in the preparation of plans for every building erected in England, a great accession of income would arise. During the past seven years upwards of 2,000,000*l.* has been expended in Hove in the erection of about 2500 houses; of these not one per cent. have been designed by architects.

Conceive for one moment to what an extent the profession would be benefited, if the documentary requirements of the local authority had been such as could have been prepared only with the assistance of an architect? But putting on one side altogether the pecuniary advantages. The very nature of the profession, the want which demands its existence, is involved in this question of plans. The architectural profession exists, because it is found necessary upon all grounds, economic and artistic, to work out a building upon paper before it is worked out in material.

No building ever suffers, on the contrary must be improved, by such an obviously correct procedure.

Has house building, then, so far progressed as an art that there is no demand for improvement? To discuss the matter no further—Is there an architect here to-day who will deny the proposition—That if every new house had to be thought out in an architect's office, committed to paper, and copies in detail sent to the local authority, there would not only be a great improvement in house building, but in the status and emoluments of the Architectural profession?

So far as a general Act is concerned, it is perfectly clear that whatever difference of opinion there may be as to the necessity of depositing plans permanently with the State, it is a requirement that neither changes with locality nor differs in degree. Whatever documents are necessary in Newcastle are essential in the metropolis. Plans are either essential or not; if essential, then they should be enforced by Statute; if not essential, then expunge the clause relating thereto in Local Acts and Bye-laws.

Plans for New Streets and Sewers.

Respecting the details to be shown on documents, which should be deposited with the authorities, to enable them to form an opinion as to whether or not the laws relating thereto are proposed to be complied with, also to insert such local requirements as are necessary but not embodied in bye-laws, except in very general terms.

The metropolis stands out prominently as the only city (Chester always excepted) where the required documents are not full, ample, concise, and specific.

The Metropolitan Bye-laws contain the anomaly, that before a local authority can construct a sewer, they must furnish the Metropolitan Board with very ample plans and particulars; but when a private owner proposes to execute the same works, the bye-law contains the meagre provision, "that plans and sections relating thereto" shall be submitted to the local authority, and then to the Metropolitan Board of Works.

If it is necessary in all the other great cities of the country to furnish the authority with full details of new streets and sewers and plans drawn to standard scales, this is surely necessary in the metropolis. It is, however, open to discussion whether or not all sewers and roads should be made by public authority, and to which

reference will be made later on. Should this be the case, the documentary requirements of the authorities would be reduced to a plan showing the situation, width, and direction of the proposed streets, and a notification that the owner was about to lay out such streets.

By "Knight's Annotated Model Bye-laws," a doubt is raised as to the ownership of these deposited documents. It has been found necessary in some towns to obtain special powers to vest these documents in the local authority. It is essential that they should remain in their custody, otherwise it would be impossible to determine whether the requirements were being complied with, except where such requirements were specified in the regulations. In the Oldham, 1880, Preston, 1880, and Stalybridge, 1881, Acts, and probably others, there are practical provisions on this point, whereby one copy is to be the property of the authority, and the applicant can claim to have a duplicate copy, endorsed with the decision of the authority, signed by the chairman.

Works of Construction in New Streets.

New streets and sewers differ essentially from new buildings, inasmuch as they pass into the hands of the State, to be maintained in perpetuity at the public expense. It is essential, therefore, that this construction should be carried out in such a manner as will not demand a heavy maintenance expenditure, beyond such as would be incurred by the local user of the street and sewer. This will occur in the former by the increased amount of traffic, in the latter from accession of the drainage of large areas outside the new street. Both of these are cases to be met by the public expense. All present requirements should be met by the owners.

Looking at this from a purely economical view, it is open to question whether private persons should be permitted to execute any works of construction which are to be maintained hereafter by the public. Whether the authorities should not perform these works, having power to obtain the costs of so doing before their execution, as is the case in London, West Ham, Hove, and other places. The Local Government Board have wisely abstained from suggesting any bye-laws as to the construction of streets and sewers, as the local materials and requirements differ so widely that no general law is practically applicable to the entire country.

The change from the system permitted under the 150th section

of the Public Health Act, which gives the owner the opportunity of making streets and sewers, to one which would cast this duty on the authorities at the owner's expense, as a matter of practice would be a slight change, inasmuch as private owners do not generally avail themselves of the privilege of doing their own work, finding it can be done better and more economically by the authorities, who under these circumstances would carry out the plan of the owners, with such modifications as appear necessary under each particular case.

An arrangement of this kind would enable the authorities to construct sewers of larger capacity than required by the immediate area to be drained, and obviate one of the cumbersome provisions under existing regulations, whereby we often see a small pipe sewer put down along the route of a main sewer, only to be replaced at the expense of the public in a few years' time with one of sufficient capacity.

Direction and Gradients of New Streets.

Gradients.

It is now generally enacted that the gradient of a new street can be controlled by the State, and all the regulations of great towns contain detail provisions to this effect, except those of the metropolis, where apparently the authorities have no specific powers on the subject.

Direction.

The direction of streets is a matter of urgent moment, upon which the Model Bye-laws are silent; any bye-law on this subject, made under the Public Health Act, 1875, being *ultra vires.*

The towns of Liverpool, Bradford, Rochdale, Salford, Newcastle, and Bolton * have recognised the importance of the direction of streets. The variation of direction is, however, limited to afford convenience of access to adjoining streets: in the two latter towns compensation is to be given to owners, in the other towns this cannot be demanded.

Probably this limited power would be practically sufficient if it were statute law applicable to the whole country. It is, however, worthy of consideration whether the State should not have absolute power to vary the route of a proposed street in any direction,

* Since writing the foregoing the author has ascertained that Leicester has important laws on the subject.

irrespective of existing adjoining streets, upon payment of compensation.

Width.

Upon no point does the law differ so much as in the width of streets, putting on one side for a moment the question of back streets. By a reference to Table D, it will be seen that this requirement varies from 50 feet in Birmingham to 30 feet in several towns for streets to be used as carriageways.

Courts may still be constructed in some towns, and are even permissible under the Model Bye-laws, under the guise of a street not intended as a carriageway less than 100 feet in length.

It is difficult to understand why any new street should be permitted to be built upon with a less width than 30 feet. What physical or other difference exists between Manchester and Liverpool, or between Manchester and Salford?—the former having abolished courts, the latter permitting them, even though 24 feet in width, with the entrance circumscribed to a 9 feet opening.

It is hardly possible to conceive a more vicious system of building, and that it should be perpetuated is a demonstration of the influence cottage property owners have in framing the laws.

Space about Buildings.

Considerable difficulties are experienced in so framing a law, which will at once give a sufficiency of air space about buildings, and not entail too great a sacrifice of property. Hitherto public statutes have left existing property untouched, and where there is no local Act to the contrary, in making additions to houses built previous to the adoption of the Public Health Act, the entire area within the curtilage may be covered over. This is manifestly insanitary, and, moreover, is unjust to owners of land not yet developed. Before enacting that air space should be provided on ancient sites when cleared for new buildings, it would be altogether more just, practical, far-reaching, and beneficial if all existing uncovered areas were to be treated as open space provided under the Act of 1875, and should not be built upon unless a sufficiency of space were left to comply with the regulations in force.

What is sufficiency, both as to area and arrangement, has been interpreted in various ways, though as the requirement is a practical one it is difficult to see why this difference exists. It can hardly

be, except in isolated cases, the value of land; for it is found that where land is as costly in one place as another, the requirements of the State vary to the extent of 100 per cent. in area, and are much more stringent in arrangement, which after all is a greater burden upon property owners than area, as area can be obtained by arrangement, so as to leave an owner almost master of the situation.

Take that law which provides that there shall be for each two storied house an open area equal in extent to one-fourth the covered area, and not less than 200 feet superficial.

The sketches will show how easy it is to comply with these requirements, and yet permit the erection of so many houses on a given area, that would shock the jerriest of jerry builders.

Look at the Bradford arrangement, and compare it with Liverpool. In the latter case open space at the rear of houses is looked upon as a prime necessity, and insists upon a distance of 35 feet between the backs of the houses, the fronts coming as close as 15 feet to each other!

In the former town the houses are back to back, yet the fronts are to be 42 feet apart!!

It is difficult to reconcile these two extremes. The author has no hesitation in saying that one of the Bradford arrangements is at once the most insanitary and expensive that could be devised, permitting, as it does, the erection of privies and ashpits in front streets, and occupying a great area of land, while it ignores the first law of ventilation, viz. air everywhere. The London arrangement, taken in connection with the permissible width of streets, permits more houses per acre than any other town in the kingdom, as it is one of the few codes that does not recognise the necessity of increasing the width across with the height of the buildings.

A fourth, and equally vicious arrangement, is that at Blackburn, which insists on a limited area only, without taking into consideration the size or height of the building.

It is probable that by taking all the regulations in force, and steering a mean course, both hygienic requirements and vested interests might be accommodated.

The question of air space for houses and width of streets should be discussed together.

Starting with the premise, that there exists no reason why these should vary in different parts of the country.

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The law, that only houses of a certain height shall be built in streets of a certain width, imposes restrictions upon future generations that appear unreasonable. If an ample minimum width of street and air space in the rear were insisted upon at first, sanitary requirements would be satisfied, and property freer from restrictions *in futuro*. Without fixing any limits, it is submitted as a reasonable proposition that air space is as much required in front as at the rear of houses; that streets, which are of insufficient width for carriage traffic, are insufficient for the ventilation of buildings; that streets and rear air space should be of such width as will not prevent houses being raised hereafter; that street and air space should be open at both ends of full width. Given these, the arrangement of unbuilt-on area may be dealt with as to proportion of road and footways, back streets and back yards, in any manner most convenient to the particular locality, and that this is precisely one of those details necessary to be decided by local authorities.

With respect to the air space for ancient sites, when such sites are cleared, it is so easy to evade the law as it stands, that if any ground covered by existing buildings is required by the State for health purposes it should be paid for; providing always, that any area which has never been built upon should be regarded as open space coming within the scope of the proposed laws.

While there yet remain a variety of matters included in Table E which might be embraced in a General Act of Parliament, the principal ones have been dealt with, and it would not be within the scope of a paper to touch upon all the numerous subjects referred to in that table, still less so to attempt to deal with all those foreshadowed in Tables A, B, and C. There is, however, still to be discussed the question of uniformity in, and the machinery for giving a Public Act effect.

Uniformity.

All persons interested in building operations agree that uniformity as far as is practicable is necessary; this clearly can only be attained by a General Building Act, embracing some or all of the matters enumerated in the table.

With a moribund Parliament already choked with work it cannot accomplish, a General Building Bill has little chance of immediate birth, still less of prolonged life, unless some energetic steps are taken by those whose opinions are entitled to consideration.

It is a curious fact, that in preparing the Model Bye-laws, which may be said to form the basis of a Building Act, no enquiry was made from the Association of Municipal Engineers and Surveyors, a body which, from the nature of its constituency, is perhaps more capable of affording accurate information in the practical working of building laws than any other; though such information should always be taken with reservation, as officials, however impartial in desire, have a leaning to magnify their office, and place more faith in official supervision than the public do.

What appears desirable in framing a General Building Act is a Royal Commission, consisting of Members of Parliament and experts in law, architecture, and engineering, to hold local enquiries on the present working of bye-laws, and hear the evidence of all persons interested. It is quite impossible for any General Act of Parliament or Model Bye-laws to be satisfactory without such enquiry. The difficulties of the Local Government Board in preparing the last set of Model Bye-laws, must have been very great, and these, it is believed, would have been materially decreased had evidence been taken, as suggested, before the draft was prepared.

While speaking upon the question of uniformity, the author has been struck with the increasing complaint of local surveyors, that the Local Government Board will not sanction any alterations being made when local authorities propose adopting the Model Bye-laws. While sympathising with the difficulties of local surveyors in administering bye-laws that are frequently in advance of the intelligence of their constituents, and appear unsuited to their particular locality, great credit is due to the Local Government Board in not permitting deviations of principle. The result is that, whereas where we had formerly between two thousand and three thousand different laws on the same subject in various localities, something like uniformity is now being insisted upon. This is a first step in the right direction.

Executive Machinery.

Given, that a satisfactory Building Act were in operation, what machinery should be provided to give it effect?

In all the large towns the present machinery could be utilised, though it is feared that the inspection of buildings is a point which does not receive that attention it should.

In a paper recently read before the Brighton Health Congress, it was stated that to properly supervise the building of a town, where two hundred houses a month were completed, six inspectors were required.

It is obvious, that if the State is to be made, to some extent, responsible for building, ample provision must be made in the way of supervision. It is worse than useless to have building regulations unless they are enforced.

Some fear is expressed, that if the State interferes to this extent the builders will get careless, and throw the blame of bad building upon the authorities, once being armed with the certificate of the local surveyor.

The granting of certificates by public officials to builders is to the last degree a pernicious system. All persons who have not figured in a police court, might with as much show of reason apply to the police authorities for a certificate of honesty. Whatever supervision there is by officials, it can never be so searching and exact as would enable a conscientious man to state he knew every part of that building was properly built, unless he remained upon it during the whole time of its construction.

It cannot be insisted upon too strongly, that the condition of a building is the responsibility of the builder.

We may then fairly assume that town authorities are becoming more alive to the necessity of public supervision of private buildings.

As an Act would apply to the whole country, where there is no staff, or where the staff is notoriously inefficient, provision would have to be made for the work.

The present arrangement, whereby the Poor Law Guardians have relegated to them the supervision of buildings, is something more than absurd.

A new system of representative county government appears to be the only reasonable way out of the difficulty.

In cases of prosecution for the infringement of the Act, some provision other than the present judicial system is necessary.

In some recent prosecutions for using bad "mortar," the author found it necessary to obtain upwards of twenty quantitative and qualitative analyses of the "mortar," to convince a bench that the rubbish called "mortar" was not mortar.

A tribunal, based on the lines of Mr. Boult's suggestion of a court of experts, or a magistrate or county court judge, with an expert

assessor to assist him, would have decided such a bad "mortar" case very quickly.

That the change from Bye-laws to a General Act of Parliament would be easily accomplished, may be presumed from the fact that where local authorities have within recent years defined the thickness of walls, little or no variation in thickness exists in different localities.

The embodiment of the size and strength of materials in a Public Act is not only a matter of sanitary necessity, but of absolute justice to many boroughs where such requirements are now insisted upon.

It is notorious that builders finding good work must be executed within the borough, migrate to rural districts just outside the municipal area, and there continue to set all building requirements at defiance. An Act of Parliament, with adequate machinery to give it effect, would prevent this.

CONCLUSION.

In preparing this paper it has been found impossible to deal thoroughly with the whole subject within reasonable limits.

In dealing with a question of this kind more information may be expected from the discussion than the paper itself.

All the author has attempted to show is:—That State supervision of private building is necessary; that uniformity in building law, as far as is practicable, is essential. That certain building requirements differ so slightly there would be no difficulty in embodying them in an Act of Parliament applicable to the whole country. That it is necessary to provide bye-laws for local requirements, but that all such bye-laws should be, as far as is practicable, alike. That before drafting a General Building Act the Government should hold local enquiries, and examine competent witnesses, giving the views of all parties interested.

That no mere skeleton Act or skeleton bye-laws will meet the requirements of the case; both must be specific, and leave little to the discretion either of local authorities or officials.

That additional building supervision is required in most towns.

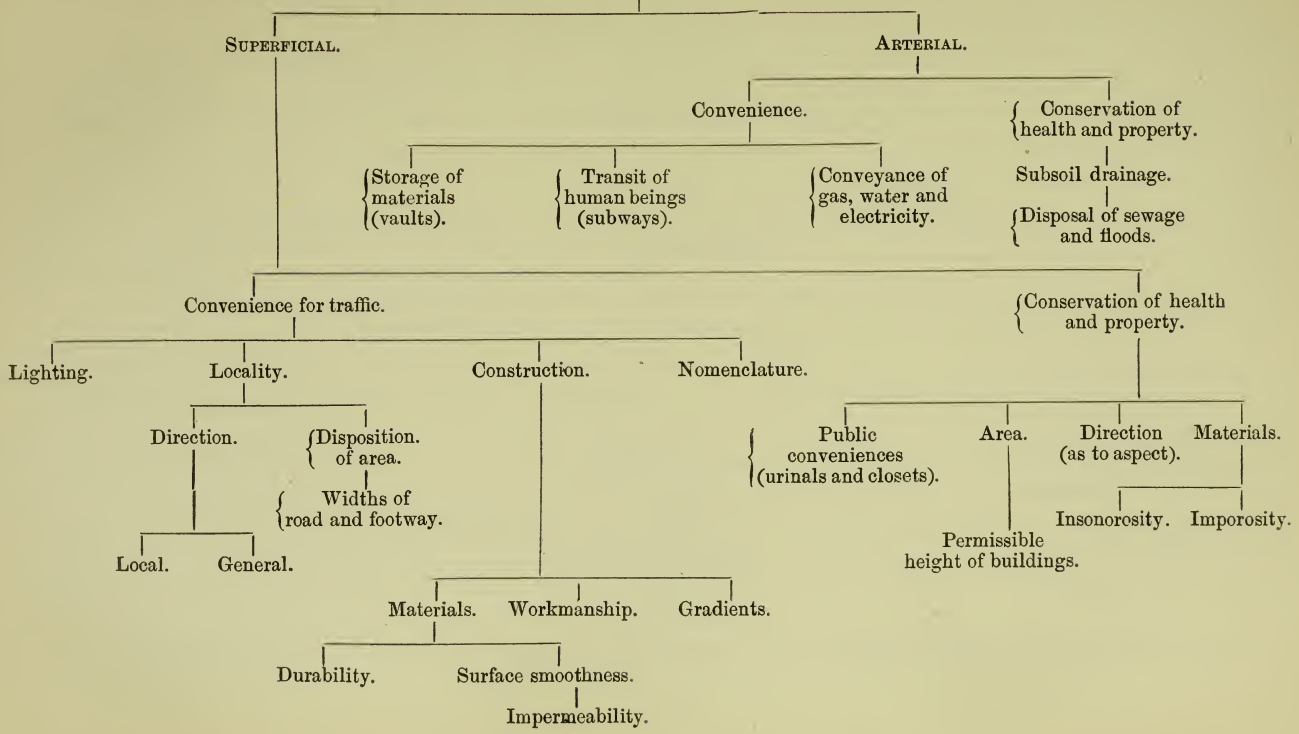
That new judicial machinery must be created to give effect to any Building Act or Bye-laws.

[Synopsis-chart showing the extent to which the consummation of State interference with private building may reach.]

TABLE A.—AS TO NEW STREETS.

Documentary.

(Plans and Notices, Deposits.)

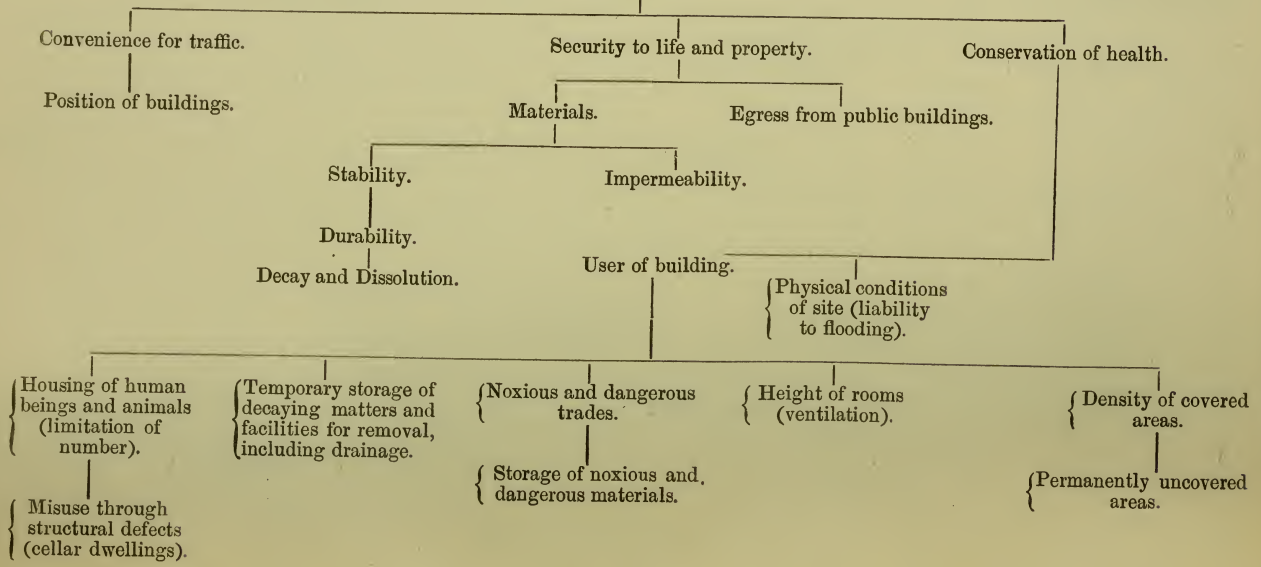


[Synopsis-chart showing the extent to which the consummation of State interference with private building may reach.]

TABLE B.

BUILDINGS.

Existing.


Convenience for traffic.
Position of buildings.
Security to life and property.
Materials.
Egress from public buildings.
Stability.
Impermeability.
Durability.
Decay and Dissolution.
Conservation of health.
User of building.
Physical conditions of site (liability to flooding).
Housing of human beings and animals (limitation of number).
Misuse through structural defects (cellar dwellings).
Temporary storage of decaying matters and facilities for removal, including drainage.
Noxious and dangerous trades.
Storage of noxious and dangerous materials.
Height of rooms (ventilation).
Density of covered areas.
Permanently uncovered areas.

[Synopsis-chart showing the extent to which the consummation of State interference with private building may reach.]

TABLE C.

BUILDINGS.

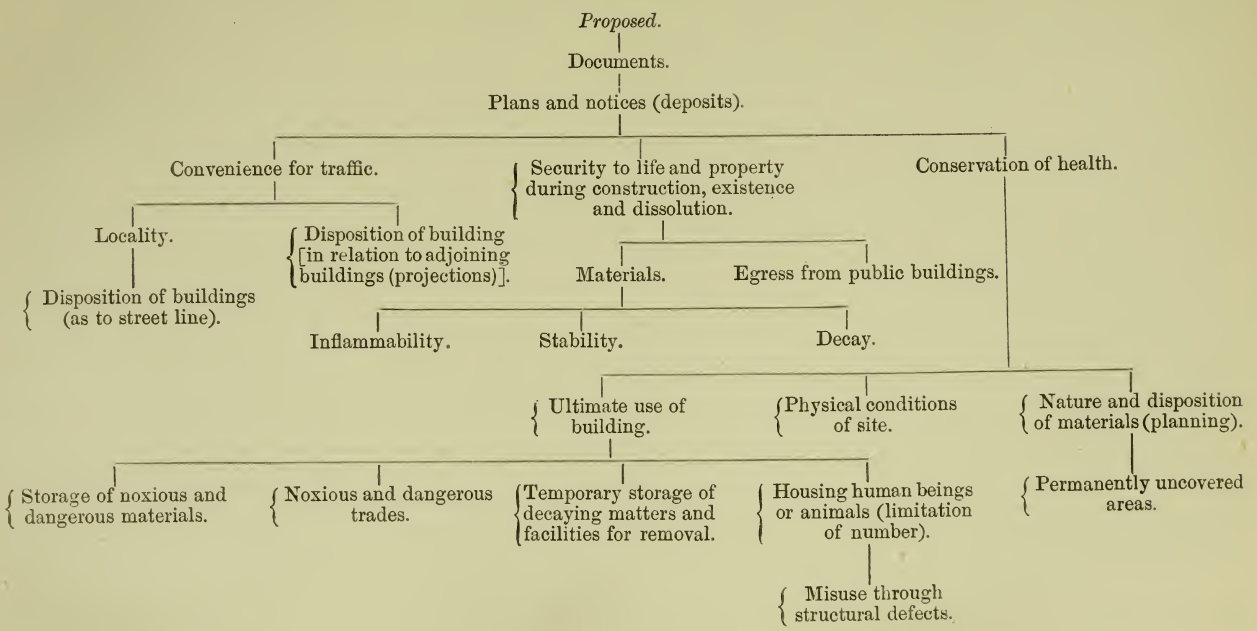

Proposed.
Documents.
Plans and notices (deposits).
Convenience for traffic.
Security to life and property during construction, existence and dissolution.
Conservation of health.
Locality.
Disposition of building [in relation to adjoining buildings (projections)].
Disposition of buildings (as to street line).
Materials.
Egress from public buildings.
Inflammability.
Stability.
Decay.
Ultimate use of building.
Physical conditions of site.
Nature and disposition of materials (planning).
Storage of noxious and dangerous materials.
Noxious and dangerous trades.
Temporary storage of decaying matters and facilities for removal.
Housing human beings or animals (limitation of number).
Permanently uncovered areas.
Misuse through structural defects.

TABLE D.

Showing the Requirements of various Towns as to the Width of Streets and amount of Air Space to each Dwelling.

	Minimum Measurements in Feet.				Air Spaces.				
	Front Carriage-ways.	Back Streets.	Back Passages.	Courts.	Square feet.	One-storied Building.	Two-storied Building.	Three-storied Building.	Four-storied Building.
Birmingham	50 *b*	*f*	*f*	20 *c*	150 *a*	10	15	20	25
Blackburn	36	12	*f*	*g*	180	*f*	*f*	*f*	*f*
Bolton	36	*f*	*f*	*g*	150	10	12	15	..
Bradford	42	*f*	*f*	*g*	150	10	12	15	..
Brighton	30	*f*	*f*	*g*	150	7′ 6″	10	15	20
Bristol	30	13	*f*	20 *c*	150	10	15	20	25
Liverpool	30	15	3	15 *e*	150	10	15	20	25
Manchester	30	*f*	5	*g*	70	9′ 6″ *h*	..	..	..
Newcastle	40	26	*f*	*g*	One fourth of area covered by building.				
Oldham	36	10		*g*	140	10	15	20	..
Preston	36	12	*f*	*g*	240	10	15	20	25
Portsmouth	36	*f*	*f*	20 *c*	150	10	15	20	25
Rochdale	36	..	6	..	225 ft. super. to each house	9′ 6″	..	..	..
Salford	36	*f*	5	9ft entrance 24	width of house	9′ 6″ *h*	*f*	*f*	*f*
Sheffield	36	*f*	*f*	21 *c*	150	10	15	20	25
Sunderland	30	18	*f*	*f*	150	*f*	*f*	*f*	*f*
Model Bye-laws (Suggested)	36	..	..	24 *d*	150	10	15	20	25
London	40	..	..	20 *e*	If the frontage of house is— 15 / 20 / 30 / above 30 — 150 / 200 / 300 / 450 feet super. practically 10 feet wide by width of building.				

a. Applicable only to house of 20*l*. annual rateable value and under.
b. Except on the Estate of Lord Calthorpe, which is exempt from this Bye-law. The width of streets generally is determined by the permissible height of houses—sometimes by length.
Generally a reduction in width is allowed when the street is built upon one side only.
c. One entrance of the full width (20′) to be provided, and if street exceeds 100′ in length Council have discretion as to making it a carriageway street.
d. All streets in excess of 100 feet long to be 36 feet wide.
e. To have both ends open full width.
f. Not insisted upon.
g. Not allowed.
In nearly all cases the area of open space increases with the height of buildings.
h. A building not exceeding 10′ 6″ in height may be built upon this.

DISCUSSION.

The PRESIDENT: We will take the discussion now upon the paper. I may say, gentlemen, before the discussion begins, that as is usual with us, we have rather more work to do than we can easily accomplish in the time, and I hope the Members will not think I am endeavouring to restrict discussion if I ask each speaker to confine the remarks he may wish to make to as short a space of time as possible. I hope no one will exceed ten minutes. We hope also to hear the opinions of those gentlemen present who are not Members of the Association, as well as those of our Members.

Mr. H. J. LANCHESTER (an architect, and Commissioner for the town of Hove): I should like to say just a word on one of the points raised in this paper. I feel rather loath to do so, as a stranger to this Association, but I shall strictly be within the limit of ten minutes that your President has laid down. I look upon the matter from an architect's point of view, and, therefore, slightly differently to the author of the paper, although I quite agree with him as to necessity of State control. That want has been very ably put before us, that there is an absolute necessity in sanitary matters for such control to protect the health of the people in all our towns. The Model Bye-laws have been repeatedly referred to, but I need not say anything of them, because they are to a great extent stale, and many of them if re-written now in accordance with present requirements, would make it a different thing altogether; things have advanced so since then. There is one point I should first like to state with regard to architects. There is a good deal said in this paper about architects' plans, and there is one thing about which I take a rather different view to that of the author, and that is when he says that "plans deposited in the hands of the local authority are valuable for reference. The author has repeatedly permitted tracings of house plans to be made from the deposited plans, the originals being lost, and the architect may have migrated, taking his plans with him." I differ with him on this question, for I think that the plans should be limited, where tracings are given, to the drains of houses, and that the rest of the plans should be kept, and put under the trust as it were of the State. I lay some stress on this point, because I feel confident that nearly all architects in the country would agree with me. I think it a very dangerous thing to have plans deposited in a public office, and for a great many reasons. I would rather

not go fully into them just now, but I may mention one, that the City Surveyor may practise, and very often does practise, as a surveyor himself. That would be one of the dangers; and I think that plans submitted into the trust of any Government office should be sacred. I think I have more reason to say something on this point, because you will notice, on the principle of "Qui s'excuse s'accuse," the author of this paper seems to have written several paragraphs in explanation, showing that he is not quite easy himself about this question. Out of 2500 houses erected in Hove during the past seven years, there is not one per cent. designed by architects. I have had as much to do, I think, as any man in Hove, with houses, and I know this, and it may perhaps explain my friend's remarks about the fewness of the architects' designs, that an architect designs one house, or perhaps two, and the design is copied right up the street. At any rate, I don't agree with the speaker at all on that subject. There is another thing I may just mention, and that is the question of these tables. I must say, to the speculative builder these tables would be something alarming, and very difficult indeed for him to follow. It is a very elaborate system, and I should like an Act of Parliament to be kept as simple and plain as possible. I should like myself, to see everything definitely specified, one clause for one thing, such as no wall should be of less thickness than 14 inches in exposed places (like some sea-side towns),—some plain, palpable thing of that sort. Elaboration in this matter I am quite sure should be avoided; and if these local or rural districts are to be elaborated in this way, and we in the city of London are to be left without, we must be very thankful at all events that the metropolis will be left to the architects, with a little freedom of control.

Mr. G. B. Jerram: Not to waste time, let me say how very thankful we all should be to Mr. Ellice-Clark for his valuable paper which he has put before us. It is so full that we cannot do justice to it in the limited discussion which the shortness of the time allows; but there are one or two points which struck me during the reading of the paper, upon which I should like to make a few remarks. The author says, "It is, however, generally conceded, that the executive officers in *towns* are men of sufficient intelligence to administer the laws;" this implies that those outside in the local districts, have no intelligence for such administration. But considering that the number of the Members of this Association in such districts is one-half of all the Members, this seems to me

rather a scurrilous remark to be made, especially as I see the paper was read before the Liverpool Architectural Society, whose Members do not belong to this, but to a kindred profession; and then he states, because a surveyor happens to be an inspector of nuisances, he is completely incompetent.

Mr. E. B. Ellice-Clark: I rise to order, I do not say anything of the sort; I merely give a particular instance, in a particular locality, of a particular man.*

Mr. Jerram: Well, I'm sorry I made the mistake, but the inference can be drawn from the paper that all inspectors of nuisances who happen to be surveyors, are incompetent. In local districts, surveyors are inspectors of nuisances, and it is provided, in the Public Health Act, that such may be the case; and from my experience where surveyors are appointed to the work I find they are thoroughly up to it, and understand their duties quite as well as those in the towns. I agree with the author in using the word ill-paid, and to think that a person with a salary of 150*l.* per annum can look after a district extending over 47,000 acres, is simply absurd; it is impossible for a man so circumstanced to carry out the laws in the way they should be administered, and being connected with another kindred Association, I know from statistics put before me as Chairman of that Association, that the salaries of these inspectors in the country are so small, that suitable men can hardly be tempted to come forward for the performance of the work which has to be done. That is the light in which I hope you will see this matter, and not say that these inspectors in rural districts are absolutely incompetent persons, any more than those in the towns. Then as regards new streets and sewers, I notice that in the Model Bye-laws, although in the Public Health Act it is enacted that bye-laws may be made for construction of streets and sewers, yet in the Model Bye-laws there is no regulation at all to compel people to put sewers in new streets, although it is provided that cesspools shall not be made within 50 feet from the house. Now, considering that the streets are only from 30 to 40 feet wide, I should certainly like friends to tell us how to get out of this difficulty of providing drainage for new houses in new streets. As regards these Model Bye-laws, I certainly agree with

* With reference to Mr. Jerram's remarks, the facts stated in the paper about the appointment of unqualified men to administrate building bye-laws in rural districts are so well known, that further proof is unnecessary; at the same time, the author is well aware that there are many exceptions to these conditions, in the fact that some most able men fill the offices referred to.

the author that there should be uniformity in bye-laws regulating building operations, but I must say those sent down by the Local Government Board were not uniform. When considering the adoption of these bye-laws in my own district, we wished to make them similar to those authorised in a contiguous district, and adopt amongst the bye-laws the one compelling the new street to be kerbed, channelled, sewered, &c., before any house was built on that street, the answer received from the Government department was, that such a bye-law was illegal and had got in by mistake! So much for the uniformity we sometimes get in local government bye-laws. With regard to this supposed uniformity, although in rural and urban districts the Local Government Board send down these Model Bye-laws, yet in many points they are found so impracticable, that in many towns the authorities draw up their own. Such towns, for instance, as Leicester, Reading, and West Ham, have procured acts of Parliament, which evade some of the Model Bye-laws, and if this is good for one place, it is good for another. Therefore I agree with this recommendation for uniformity, and I was glad to see that in the House this year those private bills, in which powers are sought to alter the law of the land in these matters, were to be referred to a Committee. I think it would be better for all Boards, both in towns and rural districts, to promote uniformity, which is so essential all over the country. Mr. Clark says, "it is notorious that builders, finding good work must be executed within the borough, migrate to rural districts just outside the municipal area, and there continue to set all building requirements at defiance." That's another slur on the local boards outside the boroughs and towns. It is a very curious thing that the death-rate in the local districts outside the large towns is considerably less than in municipal boroughs; and naturally so, because these houses being new are supervised and looked after, and we see the effect in the reduction of the death-rate year by year, showing that in this point it cannot be fairly sustained that local boards are less competent to carry out the regulations than the town authorities. Indeed, I believe myself that the regulations are much more efficiently carried out in many of the rural districts, and with much better effect, than in some of the larger towns.

Mr. Charles Jones: I may say I don't altogether agree with my friend Clark. He and I have had many a battle over these bye-laws, and I hope we have done something towards

manipulating them and getting them into ship-shape. I don't agree with what has just been said about the salaries of rural district officers, and I have no doubt that the pressure which is being brought to bear will enable them to do better before long. I know as a fact that if you have to do with jerry-builders, and carry out the bye-laws as they should be administered, then the jerry-builders skedaddle pretty quickly into a place where the bye-laws are not so strictly enforced. In connection with the plans that have been mentioned, I must say I sympathise with our friend who has differed from Mr. Clark, and spoken as an architect upon the depositing of the plans. I have had some experience in this matter, in connection with the Metropolitan Building Act as well as the Public Health Act, and I cannot see the necessity for depositing all these plans. Indeed I think they are rather an incumbrance. If the bye-laws are so framed that a certain class or rate of house, as under the Metropolitan Building Act, requires a certain thickness of wall to be in accordance with the printed regulations, as set forth in the Act, why should I, as an architect, be compelled to execute a duplicate set of plans? But as regards the drainage plans, I consider it is essential that the drainage plans of every house should be impounded, so to speak, to be referred to at any time, at any period—not for one year only after the house has been built, but seven, fourteen, twenty-five years after, when it is required to know about the drains of any house, and when, unless this course is adopted, very often no plans can be found, the architect probably having migrated, and taken the plans with him. But if these drainage plans are kept by the local authority, inconvenience of this sort could not arise, and assistance could be gained by an inspection of the plans, in the remedying of some sanitary defect which has cropped up and made its existence known. Therefore I think it essential that these plans should be deposited with the local authorities. But I do not see the necessity so clearly that the entire plans of the house, sections and elevations, should be so deposited. What on earth have the local authorities to do with the elevations? We have to see to the construction of the houses; and the elevation has nine times out of ten more to do with the credit of the architect than the plans, which are too often left as a matter of after consideration. I have often found that the elevation has been the primary object. I am sure you will pardon me in making these remarks, for I speak as one who has had

much to do with these matters for many years past. Upon the question of bye-laws and the necessity for a general Building Act, I should think that many bye-laws might be merged into a general Act for the country at large; and I do think it is a mistake that a hard-and-fast line should be laid down for all parts of the country, because all the requirements cannot be applicable for all places under all circumstances; and I am glad to see the feeling of the Local Government Board on this point is not now so determined as it was four or five years ago. Within the last few days, indeed almost within the last few hours, I may say, our consultations with the department upon the subject of alterations of bye-laws, and what we suggested years ago as the result of our experience, has led the Local Government Board to see that modifications might with advantage be made; and I hope it will be very long before the Model Bye-laws become dead letters. Day by day they are becoming improved, and the experience of the few years since the bye-laws have been out, has led the Board to see the necessity for making modifications of these bye-laws; and I am glad to find that the proposals made years since, which would not then be tolerated, are now being received. I look upon this as a most important feature, and I quite agree with Mr. Clark that in matters of this sort, that is, on practical building questions, we are surely the best to form an opinion upon, and give information which would be found of much value in the drafting of any measure dealing with the subject. There are many other points to which my esteemed friend referred, but it is quite impossible to take them up specially, as other Members doubtless intend to have a word or two. With regard to the supervision that Mr. Clark says is required to a further extent in most towns, one cannot speak too strongly of the importance of absolute supervision. You may put this Building Act into the hands of your local boards, but unless you have officers trained for the purpose and perfectly independent men, you will never get its provisions properly carried out. There are districts in London, for instance, in which they have the Model Bye-laws, but I know for a fact that they are not carried out as they should be. In my own district, we are putting the screw upon the jerry-builders, and we intend doing so until the name of the jerry-builder shall not be known there. If you turn the jerry-builder out of one district, he will sometimes turn round upon you and say, "I can do so and so in the adjoining district." He has no right to be able to do so,

and it is the duty of the authorities to enforce the bye-laws so that he shall not be able to do so, and to do that, the town authorities must be able to command proper supervision. The authorities ought to be obliged to see the bye-laws properly enforced, and not be allowed to give their surveyor instructions (as is often done by men put upon the Board for the purpose of impeding the action of the bye-laws) that he need not do so and so, and it will not matter if so and so is not enforced. Too often that is the case, and the surveyor is constantly instructed in that manner when a Board is partly composed of jerry-builders or other interested persons. It has been done in scores of cases. In Court a few days since—in connection with "an improper material" case—it was thrown in my teeth by a man, "I am allowed to do so and so in the adjoining district, and I can bring the surveyor who will tell you it is good and sound mortar. Some was placed before the Bench for examination, and a penalty of 5*l.* was inflicted. When you have a Board which consists partly of jerry-builders, or a bench of magistrates who are themselves interested parties, or a bench not very particular, it is not of much consequence whether you have Model Bye-laws or no bye-laws at all. These discussions are working out a vast amount of good, and are training our people and our local board members to what they ought to do, showing them some of the duties and necessities which ought to be a burden on the mind of every local board member as much as every local board surveyor.

Mr. Wheeler: There is one matter, sir, to which I should like to refer, and that is, not only must the bye-laws be efficient, but the officers themselves must be thoroughly competent. Mr. Clark has referred to a case in which a butcher was employed as surveyor and inspector of nuisances, and I ask you, gentlemen, can such a man, taking the question from a moral point of view, carry out efficiently the enforcement of the bye-laws? How can he properly see the bye-laws carried out, however desirous he may be of doing so, unless he is properly qualified? and I think the time has now come when some check should be put upon the appointment of these unqualified persons. Such circumstances do occur, and some law should be passed by Parliament that all men who are appointed to carry out the regulations contained in these bye-laws should be qualified men, so that a guarantee should be made to the public that local boards should not misuse their power by entrusting the enforcement of the bye-laws to men totally

unqualified for such trust. It is of no use to make efficient bye-laws unless the officers appointed to carry them out are competent men, and I say the time has arrived when local boards should not be allowed to appoint surveyors until they have undergone an examination and been found to be properly qualified.

Mr. W. Dawson: Just one word, sir, about certificates, I should like to offer. We are in the habit of giving certificates, but we do not certify the houses as being in accordance with the Model Bye-laws, but only so far as we can ascertain. The Model Bye-laws state that before a building can be occupied, the builder must give seven days' notice, and that is strictly enforced. The builder then expects something to be said whether the house is right or wrong, and if you give him a certificate that it is correct, it is I think an important matter. We frequently have persons coming and asking us if such and such houses are certified before taking them. Of course one cannot give a certificate that they are altogether in accordance with the bye-laws, but we give certificates as far as we know, and I think it but right that we should do so.

Mr. Barrett: I had no intention of making any remarks, sir, but the remarks of the last speaker lead me to say that I quite agree with Mr. Clark, that it must be a very pernicious system to give these certificates, because I don't see what value they can have. I happen to be a surveyor and inspector of nuisances, curiously enough, and at the same salary of 150*l.* which Mr. Clark has mentioned, though I am not restricted as to practice. I think Mr. Clark intended to convey the impression that bye-laws are not so efficiently administered in smaller places as in large towns, but I have a case in point for the gentleman on your left, sir (Mr. Jones). He seems quite at one with Mr. Clark that the bye-laws should be properly carried out; he does not see the necessity of having copies of plans deposited with the local authority; but here is a case in point. I was called over the coals not long ago for allowing a house to be built with its walls not the proper thickness. The deposited plans showed a two-storey house, but the man decides to put on a third floor. What is the consequence? He has his walls 9 inches instead of 14, and on goes the third floor before I get there. A little later on, there comes a gale, and the roof and the third storey are blown clean away. The walls are seen to be only 9 inches, and I am called over the coals by a member of my Board for allowing it. I think that is clearly a case showing the necessity for deposited plans. But not to trouble you any

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further, let me say I quite agree with Mr. Ellice-Clark in every remark almost he has made, and I have heard nothing yet from any speaker which has succeeded in refuting any point.

Mr. I. Matthews Jones: I am in a position, gentlemen, of being the representative of a town where Mr. Ellice-Clark's ideas cannot be carried out in their entirety. I have had the pleasure of meeting Mr. Ellice-Clark before this upon this subject, and I think he is deserving of great credit in keeping it before the Association. But there is one danger this Association should guard against, and that is that the Local Government Board should not over-ride as it were the representatives of towns and district surveyors, in regard to the application of building bye-laws. I have noticed that Mr. Marriott, before be left the Liberal party and went over to the other side, was going in for some law that would really take away a great deal of the power of supervision of building matters from local board surveyors. I do not know whether the result of the recent election has changed him on that point; but there is another Bill before the House of Commons that makes an officer over-ride the medical officer of health and the inspector of nusiances in the supervision of sanitary arrangements, and in some measure, the erection of buildings. I thought I would mention this at the outset. At the same time the town which I have the honour to represent have had Model Bye-laws before them, and committee upon committee have considered them. I must tell you we are in the fortunate position of not having any of the jerry-building fraternity amongst us, but I suppose they are down in the south, as well as elsewhere. We have no jerry-builders on our Council, and after most careful consideration, they found these bye-laws totally impracticable for the city of Chester. Those of you who are acquainted with Chester, know that we have party walls with public footway openings in them. The Row system of property is also a horizontal subdivision of ownership, so that when you pull down the property below, you pull down the owner above too. It is not a system of flats exactly, having neither a strict vertical or horizontal division. As to the concrete beds, we are founded upon a rock, and having been there since the time of the Romans, nobody can say we are not on a good standing foundation. With reference to the area to be given to properties so as to make them healthy, we stand in a very prominent position for an old town. Our last yearly death-rate was 15·5, but this last month or two it has gone up to 18·30. I thought it my duty to mention

these facts, because although Mr. Ellice-Clark may consider the points he has mentioned absolutely necessary at Liverpool or down in the south here to protect the tenants and owners of property, perhaps he would, if he had to carry out his suggestions in my town, have such a tax upon his ingenuity to make these bye-laws applicable, that he would be glad to get back to the south again.

Mr. Curry: Without going into the question whether the depositing of plans is or is not necessary, I wish to refer to a weak point as to the documentary requirements branch of the paper. With regard to the question of official State interference, it is proposed that the intentions of the applicant only shall be asked for. Even under most of the present codes of bye-laws, the intentions of the applicant at the time of giving notice are what we get, but those intentions are sometimes not carried out, nor do I see any power whereby we can require notice of any further intentions of the builder to be given or that the transgression of his declared intentions without due notice may be taken up by the local authority. In fact, it is possible for a builder to so change his intentions as to erect an entirely different structure to that sanctioned by the local authority, so that the plans as documentary evidence are valueless. Whether that is a point to be taken in hand when further powers are asked for requires some consideration, as also does the question whether something more definite of the applicant should be asked for.

Mr. Lobley: I quite agree with those Members who have spoken with reference to the depositing of plans with the local authorities, and I quite fail to see how we can possibly have the bye-laws attended to unless we keep copies of the plans. But I do not think it is necessary at all, that any elaborate plans should be furnished. All that is necessary for our bye-laws is that plans be deposited showing the thickness of the walls, brick walls and such things as that, plans of each floor, and a section. We do not want the elevation. And I do not think any architect need fear that his plans will be the subjects of copies for students, or entertain any apprehension of that kind. I have had for a number of years the custody of the plans of a great many houses, and I have no recollection of a single instance of any one person coming to look at the plans which have been deposited, except in the case of a drain, where the owner came to see where the drain existed. I quite think and agree with Mr. Clark, that it is impossible to properly carry out these bye-laws, unless we obtain plans of the

description I have mentioned. I consider Mr. Clark meant by allowing tracings of house plans to be made from the deposited plans, to convey the idea that he permitted the owners to take such tracings, and not anybody. Well, clearly that is no disadvantage to anybody; it simply gave them what they could get by measuring the building. I know something of Chester, my place being within fifty miles of there; and with regard to the adoption of the Model Bye-laws, we know they refer only to new buildings, and not to those old structures at all. There is a special proviso that these old buildings are not applied to. And with regard to the applicability of the Model Bye-laws generally, I quite think they might apply to all new streets being laid out in Chester, just as much as in Hanley or Oldham. At Hanley we have the same arrangement as is shown on the cartoon as existing at Oldham, and it works exceedingly well—no courts, plenty of space, front and back, and no back-to-back system. We have had miles of streets built within the last twenty years, and even the smallest house has a good street in front of it.

Mr. Carlton: While speaking about these plans, I may mention that I had a letter from a gentleman, applying to me to send him copies of a particular drawing. In acknowledging his letter in the spirit in which he made the request, I told him that I could not send him such copies without the consent of the architect or engineer. I did not see any objection why this particular owner should not have another copy if he had lost his, but I thought the architect should be consulted before the drawing was given. With regard to the bye-laws generally, we, at Beckenham, have recently adopted the Model Bye-laws, and we find considerable difficulty in carrying them out. Only within the last three months have those bye-laws been in force, and since the time they have been in operation, no less than fifty plans have had to be refused, chiefly on account of the clause with regard to the thickness of the walls applying to three-storied buildings. A three-storied building, according to the wording of the Model Bye-laws, need not have three separate stories; a room in the roof is sufficient to constitute a three-storied house, the wording of the Act being as follows: "'Topmost storey' means the uppermost storey in a building, whether constructed wholly or partly in the roof or not, and whether used, or constructed, or adapted for human habitation or not." For this particular class of building the bye-laws require walls 13½ inches thick for their whole height, which

appears to me quite unnecessary, the height of these buildings as a rule averaging about 25 feet. This clause is, however, evaded by builders of experience; thus the plans are submitted and approved for two storeys only, and when the buildings are finished and the surveyor has inspected the premises, the builder, without any notice to the surveyor, commences to put a flight of steps into the roof, and will thus effect the object he has in utilising the attic. Nothing in the bye-laws can prevent this being done, clearly showing how easy it is to evade its provisions. There is another matter I should just like to draw attention to. With regard to the bye-laws being old forms, it so happened that when we applied for these new bye-laws, we sent suggestions as to their alteration. They, however, were simply returned with the intimation that we must adopt them in their entirety. With regard to certificates, I do not think local surveyors themselves should be in a position to give them. It is not at all necessary, and I absolutely refuse to give them. There is nothing in the bye-laws to compel a local surveyor to give certificates at all.

Mr. Gordon: I think, gentlemen, if the Home Counties District has had in the past but few meetings, we should be congratulated on the meeting here to-day, and that we are greatly indebted to our friend, Mr. Ellice-Clark, for the excellent paper he has read, raising so many points of interest. I am somewhat disappointed, however, in one respect, so far as the discussion has gone, yet I have been pleased to hear at any rate, the opinions of one gentleman outside our Association, the gentleman who has spoken from the architect's point of view (Mr. Lanchester). I should have been very glad indeed, in towns like Hove and Brighton, if we had had that profession more numerously represented here to day, because I believe it would be better for this Association, better for the Members themselves, if there was some greater amount of intercourse between the architectural profession, who look certainly with very jealous eyes towards local surveyors in carrying out their duties. We have had to day from a gentleman who has spoken on behalf of that profession, opinions which I am not at all surprised to hear, but the greater part of which, I believe, would be very materially modified if we heard those opinions oftener amongst us, because I think we should find that explanations can be given to these gentlemen, which would disabuse their minds entirely on the points about which they seem so exceedingly jealous. That gentleman has said—and I have also been somewhat surprised to

find on my right here a very effective Member of this Association to some extent supporting him in that view—that plans need not necessarily be deposited with the town authorities if in erecting buildings the bye-laws are complied with. It is quite true that the opinion prevails amongst architects, that it is not fair and right that their plans should be deposited in the public office, in the possession of the local surveyor, who may be practising as an architect himself, and that consequently their ideas are to some extent liable to be borrowed. So far as it affects Members of this Association having private practice as local architects and surveyors, the objection is fair and valid, but, as a rule, local surveyors do not practise as architects, and therefore cannot have any interest whatever in studying the plans laid before them. For the plans to be deposited in the public office is simply in the interests of the public; and I hold it is not only necessary that we should have plans and sections, but also that we should have plans of every floor. I agree that it is not at all necessary that we should have elevations, which have nothing whatever to do with the sanitary aspect of the question, except so far as is necessary to show projections beyond the building line, and it is necessary in that case not only that sections should show them, but elevations also. So far as the town I represent is concerned, we only insist upon elevations, being deposited in the case of projecting oriel windows and upper storeys. Something has been said about the views expressed in the paper affecting the direction of streets, and it has been questioned whether local authorities should provide, or rather carry out the sewers themselves in private streets, and I must confess I believe it would be very greatly in the interests of the public if that were done. It may be of interest to the Association to know that in Leicester, we have a local Act, in which we have embodied many of the suggestions here set forth by Mr. Ellice-Clark as being desirable for the whole country. We have, for instance, power in that new Act of ours, which we obtained in 1881, to vary the direction of any proposed street, so far as it would be in the interests of the public for the future, to obtain better ingress to side streets and so on. This is the clause:

"The Corporation may at any time, after a plan for a new street has been deposited, and before the same has been sanctioned, vary or alter the intended position or direction of such intended new street for the purpose of securing more easy and convenient communication with any other street adjoining or leading thereto,

or for the purpose of making such new street communicate therewith at a more convenient level."

Then we have, too, an exceedingly useful clause, and that is an interpretation of what is to be termed a new building, and I may with advantage, I think, trespass on your time to read it: "From and after the passing of this Act, the erecting of any building: the re-erecting wholly or partially on the same site of any building of which the outer wall is pulled down to or within 10 feet of the surface of the adjoining ground, and of any frame building so far pulled down as to leave only the framework of the ground-floor storey thereof: the converting into a dwelling house any building not originally constructed for human habitation: the converting into two or more dwelling houses any building constructed originally as one dwelling house: the making of an addition to an existing building, by raising any part thereof, or making any projection therefrom, but so far as regards such addition only: and the erecting or placing of any building so as to cross over or occupy any uncovered space: shall be deemed to be the erecting of a new building, and the word 'building' shall include an erection or building of whatever material constructed, and building and lands shall be deemed to be in the street when they abut on or have an access (covered or uncovered) to the street, or when only some forecourt, garden, yard, or strip of waste or unoccupied ground intervenes between any such building or lands and the street."

If in carrying out alterations, or if in carrying out new buildings, a man has deposited his plan and proceeded with the alterations according to such plan, and he then proposes to make any further alteration afterwards, how is it possible for a local surveyor to tell what is going on unless the builder is required to give notice of that alteration? And how, also, if it is reported that some alteration has been made, can he form an opinion as to the extent thereof, unless he has plans to refer to? I hold it is not possible without the depositing of plans; and we go so far in Leicester as to require the deposit of plans in respect of every alteration, however trivial it may be. At one time alterations were made with impunity, but now that is all stopped. I am quite sure this is a very salutary regulation, and one which every Corporation ought to have. Mr. Clark has pointed out that they allow in Manchester a statutory minimum thickness of $4\frac{1}{2}$ inches for walls; and he has mentioned that in Birmingham, the streets of Lord Calthorpe's estate are not subject to the ordinary bye-laws of the borough. Surely these are things which ought not

to exist in a town of that magnitude ; and if we had a general law laying down general principles, they would not exist. Mr. Clark has raised the question—very properly so, I think—as to the construction of sewers by private owners, and I believe it would be greatly to the advantage of the public if the local authorities had power to carry out such work. The question of courts is a very vexed one amongst many local authorities, and I should like to see them prohibited altogether, unless they were practically made into streets of the width of the streets giving access to them. There is one point which I have already slighty alluded to, that is with regard to the projection of upper storeys, upon which subject I should have liked to have heard Mr. Clark's views. There ought to be some proper understanding amongst local authorities generally, as to what space is required about buildings ; not one body requiring 200 square feet, and another 100 square feet, when the local circumstances are practically the same. I am extremely sorry to find in some of the speakers' remarks, that it has been supposed that Mr. Clark has intended in any shape or form to reflect on the surveyors of rural districts. Mr. Clark's observations were, I am sure, never intended to reflect on local surveyors in any way ; he merely intended to give an instance such as any Member may picture to his mind, where the administration of the bye-laws was placed in the hands of a gentleman who had no technical knowledge whatever. I think that is certainly a state of things which ought not to be possible. The Legislature ought now to see to such matters, and if an expression of opinion—which should from us be a strong one—were to go forth from this Association at this or the Annual Meeting fully and well considered, that the Legislature should consider a new set of building regulations, it ought to receive some attention, and we should be acting for the benefit of the whole country. If the Legislature should at any time be brought to see the necessity of some action in the matter, I hope they will adopt some of the suggestions of Mr. Clark's paper and take this Association into their confidence, and not, as in the case of the Model Bye-laws, pass over our Members, whose opinions on the subject ought to be heard.

Mr. Laws: There is a point I should just like to touch upon, and that is the suggestion of Mr. Clark that the system of private owners executing their own work in the construction of sewers should be put a stop to. I for one should be glad indeed to see that done, and I hope, whenever anything of the sort is proposed

to be enforced, the voice of this Association—which should be a powerful voice too in that case—will be given in favour of making that compulsory. I can tell Mr. Clark that I come from a district where the work is very extensively done by the private owners, and the results, I am sorry to say, are disastrous. The drainage in no single point conforms to one scheme, and frequently when committee sewers are put in they are found inadequate to perform their work, and have to be taken up again and the work executed at a much larger cost than if it had originally been done by the authorities. I am so strongly impressed upon this point that I should be glad to see encouragement given to private owners to allow the authorities to execute the work, which they would do thoroughly, and that at a lower cost than any private party could do it. I think we might somehow give the private parties an interest in giving up the work; and we might facilitate the arrangement by giving them advantages, such, for instance, as spreading the repayments over a certain number of years. That would be an encouragement which the authorities might very well give them, I think. It would then become the interest of every man who had a drain to put in, to see that the authorities did the work properly, and they would get far less scamped work if they would rely upon the authorities more frequently.

Mr. J. Hall: It may be interesting to know that at Leeds this is in practice, and the authorities there pay one-half of the cost, and have done so for years. There are one or two matters I should like to call attention to. I too have found that the Model Bye-laws may not be altered unless the Local Government Board care to give their consent. At present the Local Government Board will not grant you copies or tracings to keep. That has been refused within the last few weeks. The proposal was made, but it was struck out twice in the bye-laws; and they also will not allow us to put any cost for ventilating of sewers upon the owners. We proposed to get the owners to carry up shafts outside new houses, but that proposition has been struck out three times, and we are still pressing the matter. In Torquay, as to jerry-builders, I know as a fact that two of them have really been driven out of the town within the last eighteen months, and one has said himself that he will take care not to come into the town again.

The President: If no other Member is anxious now to address the Meeting, it would be as well to bring this discussion to a close; but before closing it, I should like to say that any Member who

has not spoken but who wishes his views to be added, can send remarks in writing to the Secretary, who will take care they appear in the report of our proceedings. For my own part, I have no criticism to offer on Mr. Clark's paper. It appears to me that he has thoroughly well thought out the various points on which he has touched; and he has amply, in my opinion, justified his conclusions. With regard to the first three of his propositions—that State supervision of private building is necessary, that uniformity is essential as far as practicable, and that there would be no difficulty in embodying various building requirements in a general Act of Parliament applicable to the whole country—I do not think there can be very much difference of opinion. With regard to the fourth point—that bye-laws should be provided for local requirements, but that all such bye-laws should be, as far as practicable, alike—I certainly go very strongly with Mr. Clark, and I think that very little difference in bye-laws is needed; for beyond a few local peculiarities, the requirements of one place cannot differ very much from those of another. I may point out that if there was a general Building Act, or if the bye-laws of the different authorities resembled each other pretty closely, it would not be the case, as it now is, that every surveyor or building inspector going to a fresh place, has practically to learn his duties over again; and I may also suggest a further point of much interest to us as Members of this Association, and that is, that if something like uniformity existed in the bye-laws for local requirements, we could get in our discussions a much more effectual interchange of professional experience than is now practicable. I mean that many of the results of our own experience that we communicate to our professional brethren are now of comparatively little use, because we are speaking to each other from such totally different standpoints. With regard to the fifth point—that the Government should hold local inquiries before drafting a general Building Act, and examine competent witnesses — that, I think, we must all agree with; but I would go further, and suggest that the approval of the Council of this Association might very well be sought in respect of new legislation on this subject. I ventured in my Presidential Address last June, to hold out hope that for the future we should be so consulted; and although we have to look discouraging facts in the face, I still venture to think the day may come when we may be able to express our opinion effectually on matters of building legislation. Then as to the sixth point—

that the requirements of the general Building Act or the bye-laws as the case may be, must be specific, leaving little to the discretion either of local authorities or officials—I consider that that is a very good one. In the experience of many of us, there have been cases where our respective Boards, having that discretion, have calmly abrogated their own bye-laws; and I myself can give cases where building plans have been brought before my Committee, and my advice upon them, which was, I believe, quite in accordance with the bye-laws as they existed, was entirely disregarded. The seventh point—that additional supervision is required in most towns —I think there cannot be much difference of opinion among us on that point; but I know this, that it is a very difficult thing to induce our Boards to see the matter in the same light. The additional expense entailed by the employment of building inspectors is too much for them. I think that difficulty might be met generally by local authorities putting the charge, the expense of such examinations as were required, upon the builders; much of the objection would thus be done away with. The expense would then not be felt by the ratepayers, and that seems to me but just and equitable. I do not know that I have anything to say with regard to Mr. Clark's recommendation that new judicial machinery must be created to give effect to any Building Act or bye-laws. That requires a great deal of consideration, but I hope we shall in some way get more efficient tribunals to administer the regulations in the local districts than those which now exist. Without pledging myself to agreement with the author on all points, I wish to state my general adherence to his views, and I think he is much to be congratulated on the paper he has read. I hope it will be a useful factor in determining questions which must shortly arise in legislating for what we believe to be the interests of the public health.

CORRESPONDENCE.

Mr. A. G. Henriques, Barrister, and Hove Commissioner: A very important and at the same time a very difficult question is raised by Mr. Ellice-Clark, in his interesting and able paper on "The Supervision of Private Building by Public Authority." The limits of the whole question are far wider than those of the subject which he discusses; indeed, the true limits of State interference for the public good have still to be ascertained.

According to the old rule and practice the State was entitled to interfere whenever it pleased or had the power. According to a newer rule State interference is an evil to be restricted whenever it is possible to do so, or to be altogether prevented. Probably the truth, as ever, lies between the two extremes. There is much divergence of opinion on the subject. Radicals are at the present day taunted with abandoning their acknowledged principle of self-help in the desire to obtain State aid, for various objects. Many earnest Liberals deny the right of the State to interfere wherever private effort can achieve a sufficient result, and maintain the doctrine that State interference, if frequent, paralyses the energy of the people. There are Conservatives who advocate, and there are those who oppose, State interference, and on either side they believe that their opinions are in agreement with Conservative doctrines and ancient practices. It is clear that the question is not one of politics or of party. It is far more a social question, and has much in common with that class of subjects which are known on the Continent as included in State-Socialism and State-aided projects.

On the present occasion I do not propose to survey and determine the limits of the entire question ; much less do I desire to formulate the precise limits of State interference with regard to any special undertakings: I wish rather to point out very briefly that the arguments used by the opponents of State interference in that particular instance discussed by Mr. Ellice-Clark, and which at the present day so much affects the public welfare, are invalid, and cannot prevail against the higher public good to be attained through State interference. In the first place let us start from an admitted truth—from a well-established doctrine. I believe that it may be laid down as a fundamental rule as regards public interference with private liberty, that "wherever the public health is concerned the interference of public authority is proper and justifiable." I venture to submit that the proposition which I have laid down is true, and universally accepted. It has received the assent, in all times, of statesmen and publicists, and has been throughout the whole course of history followed in practice, under every aspect of civilisation. The public health has ever been regarded as so important and so essential to the public welfare, that the interference of the State with private right in order to promote the public health has ever been the rule rather than the exception. The law of Quarantine—even the laws of Burial, testify to the universality of these practices. I would, however, rather refer to the extremes of public interference

in matters of health as establishing the proposition for which I contend, and would therefore direct attention to the high-handed acts of State, committed by all governments during the prevalence of plagues and epidemics, and to the humble local rules for the removal of house dust and waste, the principle in every case of State interference lying between those two extremes being identical, viz. the sacrifice of private right for the public good.

Assuming, therefore, that public interference in order to promote public welfare, and especially the public health, is justifiable, I shall proceed to offer a few remarks on the special subject of Mr. Ellice-Clark's paper.

It will, however, be quite unnecessary to enter into any of the details, so well known both to the public and to the experts, of the dangers and risks to health and also to life of the ill-constructed and badly drained houses everywhere being offered to a deluded public as "eligible residences." The public in a general way know the dangers that exist, they know the deceptions that are so often practised, they know the perils that await their selection of their dwelling-house, but they are powerless to protect themselves. They cannot discover the true conditions, they cannot learn that which they are bound to know. In this condition of ignorance and helplessness the public are entitled to look for State protection. The evils referred to, should *not* exist, the dangers should *not* be present. The State should prevent the possibility of such evil-doings by the "jerry-builders." The State should interfere and control the action of those who deceive the public, and injure the public health, and such interference on the part of the State should be preventive as well as corrective. It should prevent actual and positive injury and should correct defects in plan. The evils that arise from the faulty construction of houses, from defective drainage, and from deficient light and air, are subjects which urgently require State interference, *because* private enterprise *cannot* be trusted. Private undertakings are mainly directed by self-interest and influenced by the hope of profit. Public needs are sacrificed to the greed of gain, and the practice of making razors to sell and not to shave, is emulated in the building trade. Experience has abundantly proved the direction which free trade in building is taking, and in order to prevent the continuance of these and kindred evils, I hold that State interference is not only justifiable but imperatively necessary.

With regard to the comparative merits of State interference and

local interference, it is only necessary for me to refer to the able paper of Mr. Ellice-Clark. Local authorities are too frequently and too greatly moved by local considerations, and the influences found in operation are neither the highest nor the best. Moreover, local interference offers no guarantee of uniformity or adherence to any general principle or plan. On the contrary, it is admitted that local authorities would everywhere permit endless variety of rule, and uniformity—not of style but of principle in construction—would be hopeless throughout the country. Mr. Ellice-Clark has given much interesting evidence on this subject.

On the other hand, State interference maintains uniformity, preserves due regard to general principles, and raises the level of the constructive arts. The greater breadth of view gained, the wider principles brought into consideration, turn the balance vastly in favour of State interference as compared with the interference of local authorities. In fact, the method which I venture to advocate in order to prevent the many and increasing evils referred to in Mr. Ellice-Clark's paper is, to include in a general Building Act, comprehensive enough to include the different varieties of buildings required throughout the country, all that is now known as essential to good and healthful construction of houses, with full details and special references to the different requirements of each kind of building; such an Act, however, permitting local authorities to relax where necessary the stringency of any general rule so as to meet the special requirements of any particular neighbourhood or district. In other words, let us have a general Act subject to local and special influences. It cannot be difficult to harmonise local needs with a general scheme, and the result when attained, will surely result in benefit to the public.

Before concluding these remarks, I wish to advert to a class of objections often raised by the opponents of State interference, and to which much weight is usually attributed. It is said deliberately, that State interference unduly engenders the feeling of reliance on the State, and has an enervating effect on national character. In reply, I believe it is only necessary to say that in communities where self-government does not exist, and where a paternal government holds absolute and undisputed sway, the argument may have considerable weight. In communities where the liberties are nascent, and where the national character has to be trained and developed into robustness and vigour, the argument may even be conclusive; but in England, where the government of the

people by the people exists not only in name, but in fact—where the people in each and every department of public affairs take a large and ever increasing share of public work—where they not only join in the discussion of public affairs, with an ever-increasing zest and interest, but where the people more and more largely exert an influence on the acts of governments and the decisions of ministers, I hold that the objection, however speciously advanced, has no foundation in fact or in truth. Indeed there is no fear of the people relying too subserviently on the action of the State. Those who through long experience in public affairs or acute perception of the political horizon are best able to judge the "signs of the times," have little apprehension that the influence of the State will in the immediate future override or diminish the strong individualism which now so happily obtains in this country. On the contrary, if there be any fear, it may be rather the weakening of the corporate influence of the *State*, as distinguished from the aggregate power of the *people*.

Private effort and enterprise will surely continue to exist notwithstanding the small amount of State control involved in the interference advocated in this paper. Private right will be as much respected, and private initiative be as energetic *after* the State has undertaken to control the direction of drains and to formulate the thickness of walls. Private right will not be injured but private wrong will be prevented. The ability, as well as the opportunity to inflict private wrong will undoubtedly be taken away, but the power to do rightly and to act justly will remain as clear and free as ever. The restriction which the State will impose, will be burdens on the evil-doer—on the scamping workman, and on the jerry-builder, but the honest builder will not be interfered with except as regards some general plan which he will readily adopt, and to the requirements of which he will conscientiously conform. He will benefit by the destruction of his ill-doing rivals, and the public will benefit by the possession of that which they seek, that for which they stipulate, that for which they pay their money, but which at the present day they so rarely obtain—a healthy, honestly built house. There will be a State guarantee of the *desiderata* of good construction. Fraud will be—if not impossible—exceptionally rare; deception will cease to be the rule; the building trade will lose its unhallowed name; the public health will undoubtedly improve, the public comfort will increase, and general happiness will be greater; and the principle which will underlie these much

desired changes is one often quoted and rarely controverted—*Salus populi suprema lex.*

Mr. Read: The thanks of the Members are due to Mr. Clark for his valuable paper upon a subject which is a source of trouble to every one of them.

There will doubtless be various replies to the author's question, "How far is the State justified in controlling the individual action of the builder?" The question is one of principle, and therefore should not have been applied to any particular trade or class of men, but should have ended at the word "individual." The rights of the individual are his own inherent property, the State cannot confer them, although it may allow or prevent their exercise by arbitrary power; the State may confer privileges, and remove them again—justly or unjustly as the case may be—by the same power. The exercise of any right implies also certain duties, either general or local, or both, and it is the duty of the State to enforce and regulate these duties with as near an approach to uniformity as possible, but, at the same time to allow the utmost freedom in the exercise of individual rights, provided they do not impair, or clash with, rights of other individuals, or the community at large.

Keeping these first principles in view, it would not be very difficult to frame a general Act upon the subject of the paper based upon comprehensive and well recognised principles not liable to changes of any great extent. The Act should confer the power upon local authorities to make bye-laws upon certain well-defined lines, subject to periodical revision, to keep pace with progress and invention.

Such an Act of Parliament and the bye-laws based thereon can only be drawn up with any approach to success after an impartial investigation, consideration, and boiling down of evidence given by both the officials who have to execute, and the several owners, trades, and classes upon whom the laws are to be brought to bear.

The greatest difficulties arise in settling the bye-laws because a strictly legal definition, allowing of no alternative nor discretion, has to be found for technical details capable of very elastic interpretation according to the point of view of the persons interested, and the more definite the law is the more it prevents the invention of improved methods of construction. When the persons most interested in evading the bye-laws are intrusted with the making of them the case is still more hopeless without a firm and wise central

body to insist not upon its own dogmas or crotchets, but upon the evidence and experience of the majority of the most competent persons interested in carrying out the law for the benefit of the public at large.

I quite agree with the author that deposited plans, &c., both for streets and buildings, should be as complete in detail as possible, but in exchange for this it should be illegal for any public official, his assistant, or pupil, to engage in private practice.

Looking at the fact that nearly all public streets were at some time or other private ones, and that extensions can only come from the same source, it seems to me advisable that every urban authority should provide a comprehensive scheme for the future laying out and development of the whole of their town or district both for sewers and streets, having regard to the watershed, contour lines, and other physical features of the district, and in drawing up such plans, the suggestions of owners of property or any interested person should have due consideration. Any owner proposing to carry out a portion of the scheme by making a new street should deposit the estimated cost for completing the work, including sewer, gas, and water, with the authority, who would then execute the work by contract, or by their own men, and return any balance to the owner. If any owner wished to deviate from the general scheme he should deposit plans, showing his proposed alteration, for approval. The general scheme would probably only include the main lines and arteries, so that within these there would be secondary areas capable of treatment in various ways, and it would be in these areas that the proposals of owners would come into use, and a certain amount of latitude could be given to individual action. Roads, &c., having been made by the Corporation and paid for by the owners should be as a matter of course dedicated, unless this is objected to by the owner or majority of owners, if more than one is interested.

Sewers, water supply, and gasworks should be under control of public authority, all connections with either sewers, water, or gas mains to be made by servants of the authority only.

The boundary of a town or district should coincide as nearly as possible with a drainage area or watershed, and not, as is usually the case, be bounded by a stream, brook, or valley line, necessitating an arrangement between two adjoining authorities for draining the one area into or through the other.

Plans of buildings complete in every detail should be deposited for approval, the building line of frontage, width of lots, &c.,

having been settled by the authority and the landowner who paid for the street before a house is erected, or a lot sold.

It is frequently a great hardship to compel owners to spend money in making wide streets in excess of the traffic ever likely to use them, in order to obtain air space; for instance, it is easy to conceive a position where a 30-foot street is ample for the traffic, but it has to be made 36 feet for air space, whereas the case would be better met by making a 30-foot street and setting back the frontage line of the houses 6 feet on each side, making the air space 42 feet between the houses with a minimum amount of expensive road-making; this, however, raises a difficulty in deciding the positions adapted to such an arrangement, as it is obvious that it should not apply to through lines of traffic.

Bye-laws should be subject to periodical revision or provide alternative methods for any debateable matters, or they will prevent progress and invention by an absurd assumption of infallibility. Bye-laws, while enforcing strength, durability, and sanitary condition of houses, should not unreasonably increase first cost beyond requirements of locality.

Care should be taken in limiting height of buildings in proportion to width of streets, that a public building, such as a church, is not thereby prohibited.

Generally I agree entirely with the author of the paper, but am not sanguine that his proposals will ever be realised, unless the application of the Corrupt Practices Act to municipal elections results in a better class of men being returned, capable of administering the law, and not interested in evading it and rendering it a dead letter.

Mr. C. Jones, Ealing Local Board, supplies the following Abstract of Replies to Circular Letter addressed to the Surveyors of Towns connected with the Association.

Return with respect to House to House Inspection.

Questions Asked.	Replies from 83 Towns.
Do you make Periodical Inspections of the Dwelling-Houses in your District?	Yes, 53. No, 30.
If so—How often?	The replies give periods varying from once in three months to once in two years, and in a few cases (large towns) the Inspection is continuous.
By whom is the duty carried out?	By the Sanitary Inspector, under the direction of the Medical Officer of Health.
Is it confined only to the poorer classes, or are the whole of the Houses visited?	All the houses, 26. Only the poor, 27.
Do you find any difficulty in carrying out the work?	No difficulty.

JOINTING SEWER PIPES.

By H. PERCY BOULNOIS, M. Inst. C.E., Borough Engineer, Portsmouth.

The object of this paper is twofold—

First, to open up an important subject for discussion amongst the Members of the Association; and

Secondly, to introduce to their notice an improved method of making the joints in pipe sewers or drains.

It is evident that, however good a material may be selected for the manufacture of sewer pipes, and whatever care may be exercised in making them, they are quite useless unless the method of jointing them together can ensure the joint being perfectly sound and water-tight; any defect at this point will allow the liquid portion of the sewage to pass out and pollute the adjoining soil, the solid portions remaining behind in the drain or sewer and eventually choking it.

It is scarcely necessary to point out the serious consequences which are thus entailed upon the occupants of houses adjoining a sewer or drain of this description; the effect of one or more bad joints in a length of 20 or 30 feet of a house-drain composed of 6-inch or 4-inch pipes is that the liquids pass through, the solids are retained in the drain, and this accumulation is piled up month after month; and it is not till disease or even death proclaims that there is "something wrong with the drains." An investigation follows, which leads to the discovery that the drain is thus choked with an almost solid accumulation; although it may have been apparently acting very well for months past, nothing has really reached the sewer. A cause is often sought to account for the chokage of the drain in this manner, but the experience of the author has shown him that the principal reasons for failures of pipe drains or sewers arise from imperfect jointing, and not from either insufficient fall or flushing power, or from some foreign matter entering and obstructing the passage of the sewage.

The author draws attention to some early specimens of socket pipes which he produces, as they will no doubt be interesting, as showing the gradual development of the spigot and socket out of the ordinary butt pipes.

When first socketed stoneware sanitary pipes were introduced, they were jointed together with clay, and this practice still continues in some parts of this country, notably at Portsmouth, it being contended that a good clay joint is better than a bad cement joint, and also that the pipes jointed in this manner are so easily taken up; this latter argument rather tending to show that the work may not be perfect or it should not require to be taken to pieces again when once laid.

There can be no doubt that a properly made cement joint is better than one made with clay: the latter is a soft material which must eventually wash out, as it does not (like cement) improve with time; and as it has no stability, no strength is given to a length of pipe to resist settlements, and the practice of clay joints should be looked on with great disfavour.

With regard to cement joints there is no doubt that to make a good sound even joint with whole socket pipes is an exceedingly difficult matter, and requires the most constant and careful watching on the part of the inspector, and even then he cannot be quite sure that all the joints are perfectly sound or that some cement will not find its way into the channel of the sewage and cause an obstruction. Without careful watching, the usual practice of the workmen is to dab the cement on by hand just at the edge of the socket, or large quantities are pushed through into the pipe, there to form the nucleus of serious obstructions. Even with the best intentions it is not easy to make a thoroughly good joint, when we consider how difficult it is to get the spigot end of one pipe to enter the socket of the one behind it without pushing up all the cement in front of it, the almost impossibility of ensuring that the spigot takes the exact form and level of the invert of the socket, thus an uneven invert is made in all sewers or drains constructed in this manner; the spigot also is rarely driven quite home, and it is not possible either to prevent the cement dropping out of the soffit of the socket.

These faults are magnified with all pipes over 9 inches in diameter, as they are not easily handled, and no doubt you have all of you seen the rough hauling on ropes, the shoving with crowbars, and hard language that take place in laying lengths of stoneware

pipe sewers, and bad workmanship is often the result, even if the pipes are not cracked or injured. Owing also to the present method of jointing pipes it is difficult for the Borough Surveyor or his assistants to see whether the joints are properly made except for the last pipe laid; and if it is found necessary to take out a pipe, either for inspection, defective work, or for any other purpose, to put a pipe in its place involves the disturbance of a considerable number of pipes on each side: the effect of this disturbance upon the joints can be imagined.

The difficulties and imperfections the author has enumerated having been largely felt, a great number of inventions have been from time to time brought to the notice of sanitary engineers and the public, one of the first being that known as "Jennings's Improved Saddle Pipes," which were introduced in the following words:—

"Prior to 1854, drain-pipes were all made with sockets, and entered more or less one into the other, the weight of the pipes and their contents resting on the sockets formed to receive them. Those interested in the proper execution of the work could not see if the invert was true or the joint (if made at all) perfect. In cases of stoppage, the pipes were as a sealed book or a locked portmanteau without a key, examination being impossible without destruction, and perfect restoration equally difficult. Junctions to finished lines of pipes could not be introduced without breaking up, dislocating, and destroying the continuity of the drain."

"In 1854 George Jennings produced the first improvements in drain-pipes; the ends of each pipe he supported by earthenware chairs with broad bases; the bedding down of the pipes made the joints, and the distance between each allowed those having the care or execution of the works to see if the pipes were truly laid and jointed; while the removal of a saddle cover permitted examination, 'or the introduction of a junction' (mechanically), without trouble or disturbance of the general drain."

The objections to Mr. Jennings's method are:—

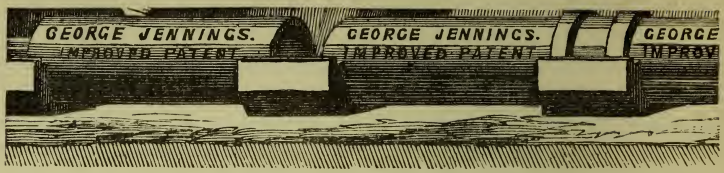
(1.) The pipe does not rest on the bottom of the trench, but only takes a short bearing on each rest.

(2.) There is a want of stability in any length of pipes so laid.

(3.) The removal of the saddle cover could not be effected if it was (as it should be) cemented down.

(4.) The numerous operations and length of time necessary in laying.

The following drawing describes the system :—

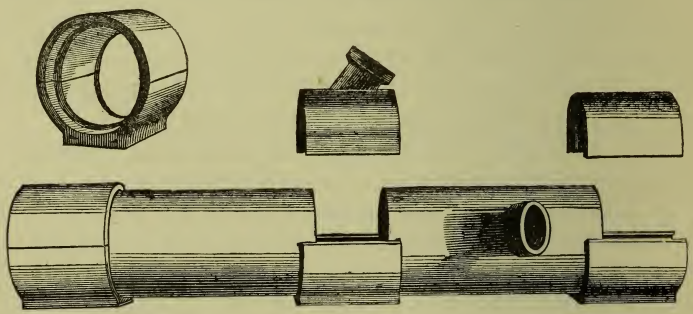


Somewhat similar to this method is that known as "Stiff's Improved Registered Drain-pipes," which is described as follows :—

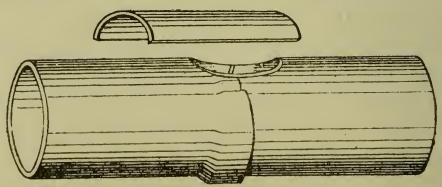
"The improvement consists in the use of a *chair* and *saddle*, the former with a broad, firm base of great strength, in the rebates of which the ordinary butt-joint pipes are laid. The pipes are made 2 feet 3 inches in length, and the chair is 9 inches long between the rebates. One pipe with chair and saddle will therefore measure one yard lineal when in position. Junctions with the main drain can be made either in the straight pipes or in the saddle, either at an oblique or right angle with the drain."

The objections to this method are similar to those enumerated in the case of Jennings's patent.

Drawing of "Stiff's Improved Registered Drain-pipes."

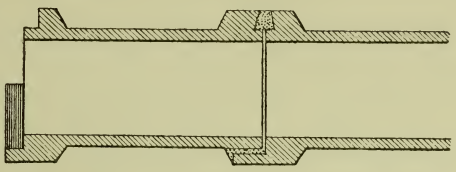


Another patent is that known as "Creeke's Patent Capped Pipe," which consists of a rather long socket and a cap covering a part of



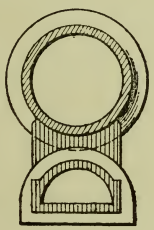
the joint, as shown in the accompanying diagram; but, beyond the advantage of having a cap over the joint, not much is gained by this method.

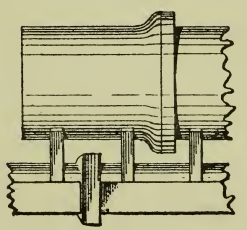
"Mawbey's Patent Grooved Socket-pipes" are probably known to most of you, but have not, I believe, gained much favour; the following diagram explains them; here there is an improvement in the method of jointing, but no cap for inspection, or other advantage.



"Stanford's" patent joint is too well known to need any description from me; it is invaluable in running water, or where speed in execution of the work is necessary, but there is of course no cap, and beyond a fairly good joint no other advantage is gained.

"Brooke's Patent Subsoil Drain" is also of great value where subsoil water has to be dealt with, but the joint is made in the ordinary manner, and there are no inspection covers; one great advantage of this system lies in the fact that the "rest" bears evenly on the bottom of the trench although the pipe itself is carried on bearings about 1 foot 6 inches apart; the following is a diagram of this method:—





"Doulton's Patent Opercular Pipe" is described as follows:—

"The object of these pipes is to afford an opportunity for examining and cleansing. In the process of manufacture of the opercular pipe a partial division of the substance of the pipe is made, leaving sufficient material to preserve strength. Both kinds of pipe are fired in one piece, and perfect accuracy of form is secured. By the insertion of a chisel the upper pieces may, at any time, be detached without the slightest risk, and afterwards replaced, so as to form a perfect and accurately fitting cover."

More than ten years ago, Mr. Bothams, the City Surveyor of

Salisbury, patented what is known as the "Perfect Drain-pipe," or "an improved form of socket-pipe, to ensure their being correctly and securely united." I cannot do better than quote the words that Mr. Bothams used in introducing these pipes; they were as follows:—

"During the last few years great improvements have been effected in the manufacture of pipes; the general regularity of form, the uniting of the socket to the pipe, and the smoothness of inner surface have steadily progressed; *the looseness of joint has, however, hitherto remained unaltered,* and some makers attempt to remedy the defect by forming the socket as small as possible—so small, indeed, that the space left between pipe and socket is not sufficient to allow of the easy insertion of the material to make a proper joint; and pipes are occasionally met with which cannot be got into the socket without being chipped.

"With this looseness of joint any pipe may be laid projecting above the next one, or may afterwards be caused to sink by the ramming in of the earth above it.

"Twenty years' experience in the construction and management of sewerage works has shown the designer of the Perfect Pipe that some plan was needed to enable ordinary workmen to unite drain-pipes correctly and securely together.

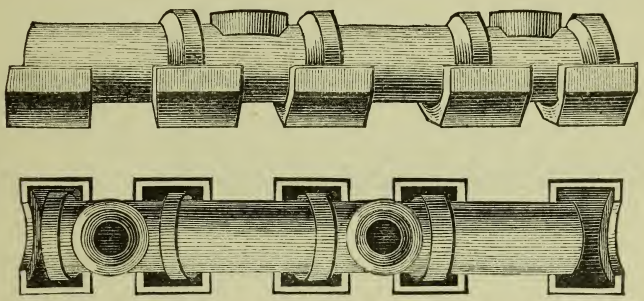
"It is evident that the construction of drain-pipes with the view to their being properly united has not received that attention which its importance demands, considering that there are about 2640 joints to every mile of pipe sewer, and from thirty to forty or more joints to every house drain; that drains are often laid under dwellings; that one pipe projecting above another may present an obstruction in the drain and be the cause of stoppages; or from the joints being broken or open may allow foul air to escape, or the fluid part of the sewage to soak away, leaving the more solid part to accumulate and ultimately stop the drain; or, where the subsoil contains much water, the defective joints may allow water to enter the sewers to an injurious extent."

Mr. Botham's patent consisted in placing three small guide-pieces in the socket and three guides on the spigot end of an ordinary pipe, but these additions did not overcome the objections so ably demonstrated by him.

More recently than the patent I have just mentioned "Maguire's Patent Safety-joint Drain" has been introduced, which consists of a "hollow cradle of glazed earthenware, in which the pipe and the

socket of next drain rest," and, in addition to this, "an open inspection hole, round or oval, with loose cover, on every alternate length of drain-pipe," for purposes of inspection and "smoothing the interior joints."

The objections to this system are numerous, amongst others the fact that there is no room for side junctions to enter between the cradles, as the following drawing will show; and there are no means of inspection.



The next method which will be mentioned is that known as "Jones's Patent." Here we have a cap directly over the joint, a step in the right direction, but there is no *rest* for the pipe, which still bears upon the socket, and the pipes cannot be let down into their place, but have to be forced in.

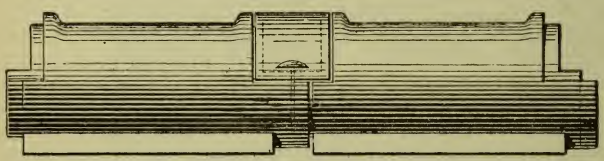
The well-known and scientific plumber Mr. Buchan has also patented a pipe; the objections to it being no improvement in the method of jointing, and the obstruction the rests would cause in the bottom of the trench, which they would scrape and disturb and tend to prevent the spigot entering the socket thoroughly home.

Having thus far described most of the different pipe-joints with which the author is acquainted, he will leave it to the Members present to fill up any omissions in his list, and he will pass on to the second part of his paper, viz. to introduce to your notice an improved method of making the joints of sanitary pipes which the author, in conjunction with a Mr. Hilder, has introduced.

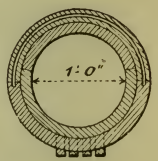
A sample of a 12-inch pipe which is produced will explain itself, as will also the following diagram. The pipes are made double socketed with a cap to fit on, a rest being made under each pipe; the following advantages which this method has upon the present systems may be enumerated as follows:—

(1.) *Simplicity of laying.*—This is achieved by making the faucet end of the pipe semi-socketed, which allows the spigot end to drop vertically into position, thus doing away with the necessity of pushing the pipe horizontally, a practice which is much to be condemned for many reasons, some of which have been enumerated.

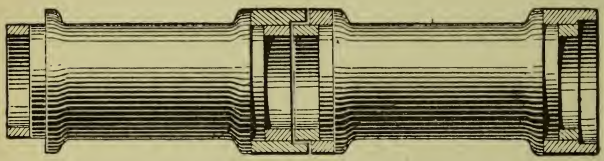
(2.) *Easy handling in laying.*—The pipes can be handled at both ends from the top; the man engaged in the work is thus able whilst in the trench to place the pipe directly in position; this does away with the use of the rope and crowbars to get the pipes into place.



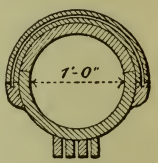
SIDE ELEVATION



ELEVATION OF SOCKET END



PLAN OF TOP



ELEVATION OF SPIGOT END

(3.) *Evenness of cement in joint.*—An even thickness of cement all round the joint is secured, and no cement can remain in the pipe to form a nucleus for obstruction, as in the ordinary pipes.

(4.) *Water-tight joint.*—This is ensured without the necessity of surrounding the pipes with concrete, a precaution which is now necessary with ordinary pipe sewers, owing to the difficulty experienced by the workmen to get the cement *under* the socket, the most important place of all.

(5.) *Access at the joint.*—This is a most important matter, not only at the time of laying the drain or sewer, but also afterwards. This has been attempted by a great number of inventors, but never exactly at the joint, as in the pipe the author now introduces.

(6.) *Uniformity of invert.*—This is never secured with ordinary pipes, there being generally a small weir at every joint in a

finished pipe sewer; in the new pipe this is always avoided, the level of invert being secured without all the trouble and loss of time entailed with ordinary pipes by packing with pieces of slate, &c., and then never securing the object.

If with the "Acme" pipe one pipe does not *quite* fit the other, it is easy to make a true invert from the opening above with cement by the hands of the workman.

(7.) *Facilities for inspection.*—No scamping can take place, as each joint can be seen, after the work is finished, by the inspector before the cap is put on.

(8.) *Checking the levels.*—In using the boning rod or levelling staff it can be placed directly on the invert of each pipe if thought necessary, instead of trusting to an elbow or ⊤ at the bottom of the rod, or taking the level on the outside of the socket, as is now the practice. In case of a sinkage occurring in the sewer after it is completed, it is easy to excavate the ground, remove a cap, and take the necessary levels.

(9.) *Testing the sewer.*—After a length of sewer is in, it can easily be tested for tightness by filling it with water at any joint from the nearest hydrant.

(10.) *Facilities for removal of obstructions, &c.*—Each joint remains an inspection point for ever; there is no danger of sinking down from the surface of the road to a wrong place.

(11.) *Fewer man-holes necessary.*—Neither so many man-holes or lamp-holes will be necessary under the circumstances enumerated in the preceding paragraph.

(12.) *Ventilation.*—Each joint can be made into a ventilating shaft if desired, either during construction of the sewer or at any time afterwards.

(13.) *Ease of removal of pipe.*—Any pipe can be easily taken out of a length of finished sewer at any time without disturbing more than one other pipe. The usual method destroys the joints of several pipes both ways, as they have to be lifted.

(14.) *Rigidity of joint.*—The cap forms a species of keystone, thus assisting the rigidity of the pipes to resist the side thrusts often occurring from slips, or even the ordinary filling in, which throws the lines of ordinary pipe sewers much out, besides opening the joints.

(15.) *Advantages of the rest.*—Owing to the rest under the pipe the weight does not bear upon the sockets, as in the ordinary pipe; the under portion of the joint at the socket can also be got at and

seen, and also a most important advantage is the fact that the bottom of the trench or level bed of concrete on which the pipes are to rest can be made to the finished inclination of the sewer; no packing is required or excavation under the socket, and a very large proportion of the work now obliged to be executed in the trench in order to get a properly finished pipe sewer is thus saved.

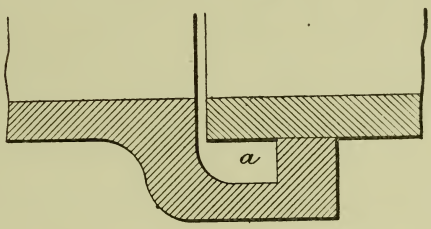
The first cost of the Acme pipe is of course more than the ordinary socket pipes, but even putting aside the advantages which the author has enumerated, he believes that a saving would be effected by their use, if a really water-tight sewer is insisted upon. The loss of time involved in getting ordinary pipes into their proper place, the packing and pushing, the difficulty of cementing the joints, whilst perhaps ten men stand idle at the top of the trench, the waste of cement and concrete, and general difficulty of the work, especially where water, loose sand, or other impediments are encountered, render the cost of the pipes but a small fraction when compared with the finished cost of the sewer.

CORRESPONDENCE.

Mr. W. Dawson: I think the great drawback to the general use of the pipes described by Mr. Boulnois is the cost and the trouble of jointing. We have just completed an 18-inch sewer in this district. I may say we have any amount of water, and in some places running sand. The sewer was laid about four or five feet under flood level, the joints were specified to have a sufficient quantity of gaskin or spun-yarn wound upon the spigot end of the pipe, and afterwards rammed in so as to fill the space between the socket and the pipe end for a depth of at least $\frac{3}{4}$ inch all round; the joint to be completed by filling in all round with cement, mixed in equal proportions with fine clean sand. The method of laying was as follows: each pair of pipes was jointed above ground, so that we were certain every alternate joint was perfectly sound; then two pair of jointed pipes were lowered into the trench and a man kept inside while the other joint was made, to see it was well jointed and that no cement mortar had got squeezed up inside the invert. The ground had all been got out to the required level, including the 6 inches of concrete, and a concrete saddle was laid in the trench to come in the centre of every pipe, leaving the sockets free. When a length from manhole to manhole was finished, the pipes were tested, before the 6 inches of concrete

was put round, and in every case the sewer was found to be perfectly water-tight.

Mr. Joseph Hall: The difficulty of pipes settling at the joints has been successfully met in the "Rest-pipe," which has been introduced to my notice some time ago by Messrs. William Ingham and Sons, of Wortly, near Leeds. In this system the spigot end of one pipe rests upon a properly shaped bearing in the invert of the socket of the next pipe. The space *a* is filled with cement,



and the rest extends from one-fourth to one-sixth the circumference of the pipe, the remainder being jointed in the usual manner.

With regard to the system of capped junctions proposed by Mr. Boulnois, it appears to have the defect which is fatal to all capped pipes. Either the cap must be fixed in such manner that the joint is easily broken without damage to the cap or pipe, in which case the roots of trees readily find an entrance and rapidly fill the drain, or the cap must be fixed with cement, when the advantage of a cap is not very apparent over the ordinary pipe. During the autumn of 1883, about 120 yards of pipes were laid on the *chair and saddle* system. When examined they were found to be almost entirely closed by the fine fibrous roots of trees growing from 15 to 20 feet distant, and these roots had entered under the junction caps.

VISITS TO WORKS.

(1.) *The Ventilating Furnace at Roedean.*

Mr. Ellice-Clark: We will now proceed to see the furnace at Roedean, which is used for ventilating a portion of the intercepting sewer which carries off the whole of the drainage of Brighton; the sewage and storm water are conveyed by gravitation from the summit levels without a check to the sea front. There is the main drain, known as the Brighton intercepting and outfall sewer, which is 7 miles in length; it runs along the entire length of the front, parallel to the sea. This sewer is between high water and low water. The summit level of the sewer is high water, the lowest level of the sewer is low water. The sewer being 7 miles long, and the range of tide being about 21 feet, the sewer has a fall of 3 feet in the mile. About $3\frac{1}{2}$ miles of the sewer are in front of the towns of Hove and Brighton; the rest is in deep tunnelling in the chalk Downs, and there are very few houses, except in the village of Rottingdean, connected with it. What you are going to see to-day is the furnace on the intermediate level of the sewer. The whole of the portion draining the towns of Brighton and Hove are cut off by a flap in the sewer, and everything eastward of that to the furnace is ventilated, or supposed to be ventilated—and you must form your own judgment entirely on what you see—by the furnace which Mr. Lockwood, the Borough Surveyor of Brighton, has had in operation for a considerable time. When we get there and hear the explanations from Mr. Lockwood, or his assistant Mr. Palmer, you must remember this furnace does not settle in any way the question of the ventilation of sewers. It settles, perhaps, the question of the ventilation of a particular length of sewer into which there is not an opening, or only two or three openings; so that should be borne in mind when you hear the value of this furnace, as no doubt you will presently, very elaborately described, that there are about 350 or 400 openings to the mile in the Hove sewers. With regard to the Sea Wall works, they, I hope, will be interesting to you. I am exceedingly sorry the contractor has not been able to get a section of the wall in, but that will not matter

much to engineers. You will have no difficulty in understanding the works as you see them. The whole question of the sea defences of Hove is in a nutshell. All the land along the adjacent coast has hitherto been protected by a natural bank of shingle, resting at an angle of about one in eleven, and thrown up to a maximum height of 10 feet above H. W. O. S. T., i. e. 21 feet above Ordnance datum. The shingle for about 40 or 50 years has accumulated in front of Hove and a certain part of Brighton by a natural process. All this shingle comes from the west and flows to the east. Sometimes we lose in a few tides 100,000 tons, simply from the natural action of the sea on the foreshore. About five years ago there came into Hove a scarcity of beach. Previous to this, a bare space had been travelling from Selsea Bill, which you know is west of us, and that bare place took seven or eight years to reach us at Hove. It travelled along the coast, a beach famine, and passed partly through Hove to the west of our border, which was very well protected with beach, to the east, where you will see the sea wall has its commencement. This bare space has got into Brighton, and will pass along in front of Eastbourne and other places westward, in my judgment, and of all the towns along the coast. The method of protecting this particular part of the coast has been to throw out groynes, generally timber structures, from 200 to 280 feet long, placed at right angles to the foreshore, which intercept the beach mechanically during heavy weather. The effect of these groynes has been to accumulate a large amount of beach on the weather face, but to denude the foreshore on the leeward face. You will be shown to-day some groynes of the old fashioned type, which have been erected at right angles, but you will also see some groynes erected, placed at angles varying from 45 degrees to 80 degrees in an easterly direction, on a different principle, an original idea of my own design to create a level beach. The groynes bring about, not an absolutely, but a practically level beach. These works have been subjected to bitter criticism, so much so that even within the last twelve months there have been ideas of taking them up; but (one does not like to speak of a personal matter) my opinion has been strongly fortified, for when Sir John Coode was called in (as perhaps he will personally explain later on) he at all events determined to leave them *in situ*. You may hear something of this on going down to the foreshore works. In consequence of the dearth of beach, the Hove foreshore has been very considerably denuded during the last five years, and we have lost about 100 feet of land. You will see

where it has been eaten away into the lawns, and the time has now gone by (it went by some two years ago) when groynes would be of any service to us. I projected a wall in front of a certain portion of the beach we have to protect. Sir John Coode was called in, and he said "not only put a wall along this portion, but extend it along the entire portion you have to protect." The Brighton Corporation are in the same position as we were about three years ago. You will see as you pass by, next to our border, a very bare and bad place, and I do not hesitate to say, in the presence of the reporters, that the Corporation of Brighton are in this matter in "queer street." In my judgment the groynes they propose to put out, and the scheme you will see to-day being actively pushed forward by Mr. Lockwood, will not avail them, and nothing but a heavy and substantial timber breastwork put down immediately, will do them any good, there being no time to put a wall in; the encroachments will take place before a wall could be erected. We will now, with your permission, sir, go to Roedean and see the furnace, but always bear in mind what I have told you about its virtues.

Mr. GORDON: May I suggest, sir, that we should follow the same course in respect to anything we may now see, as we have observed in respect to Mr. Boulnois' paper, and send any comments we may wish to make to the Secretary, to be inserted in the report of the proceedings.

The Members then proceeded along the sea front to Roedean.

On arrival at Roedean, Mr. Lockwood conducted those wishing to go, down the circular staircase to the sewer; and, exhibiting sectional drawings of the intercepting sewer, the furnace and the shaft, he supplied the following information in response to the various interrogations of the Members:—The front of Brighton is about 3 miles in length, speaking in round numbers; and an intercepting sewer 5 feet in diameter at the western end, increasing at about the centre of the town to 6 feet, and then to 7 feet in diameter, extends for 4 miles beyond the town, in an easterly direction to this shaft, which is nearly 3 miles from the Steine and about $1\frac{1}{4}$ mile from the eastern boundary of the borough. This half of the sewer has only three inlets in it, and therefore the shaft here enables us to keep a constant current in this direction. The sewer has a fall of about 3 feet in the mile, commencing at high water at Hove and terminating at low water mark at Porto Bello. We have come very much against the grain

in erecting our ventilating shaft here. It should have been put up at the other end, at Hove, or westward, but it was impossible to get a site, the people there having a strong prejudice against it. When the sewer was put under my charge, I felt it important there should be some efficient ventilation, and these works were erected with the view of securing such a desirable result as far as possible. At this point we have put in an ordinary flap valve, which prevents the air coming from the eastward, and erected this shaft, which I am happy to say has been very successful. The sewer is 90 feet below the surface, and the working of the shaft is as simple as it possibly can be if you look at this section. The valve, as you see, is in four sections; these parts simply open with the current, and shut against any air coming from the eastward. It does not ordinarily operate further than the Steine valley at Brighton, which as I believe I mentioned, is about 3 miles distant from here. Beyond that, the sewer is ventilated in the usual way with grids and huts on the beach, just as it was here originally, but this side of the Steine valley we have stopped up all the grids, and what few entrances we have we keep stopped as much as possible. In time of heavy rain the sewer becomes full, and for a short period the ventilation is suspended, but I have always found, in spite of that, so much fresh air and water come down at such times, that the sewer is as sweet then as at any other time. As I said before, the proper thing would have been to have had this arrangement at the other end of the sewer, but we could not get it, and we must be thankful for small mercies, I suppose. If we have rain in addition to a high tide, the water does occasionally fill the sewer, and then this furnace would not be acting for that time. I have tested it very carefully, many times, and never found a less velocity of the air than 100 feet per minute between the Steine Valley and the shaft. We more often than not, find the current down the sewer towards this shaft much more than that. If there were more openings in the sewer it would certainly be more difficult to deal with. The only openings we have between the Steine Valley and this shaft, are one main sewer and two small junctions (pointed out on the drawings); there are no surface gratings. We cut off the Black Rock Valley by a trap from this furnace. With regard to the question as to whether our iron pipe into the sea is uncovered, it is so at low water during the spring tides, but at other times the end of the pipe extends to low water. The original openings between here and the Steine were about 200 yards apart. If

we were to reopen them they would take away the draught from the sewer. It would be very difficult to apply a similar system of ventilation to the ramifications of town sewers generally. The whole of this part of the sewer is under high water. With our street sewers we get all kinds of ventilators, up breweries, churches, factory chimneys, &c., though we have not many factories, for our factories are chiefly hotels, of course. As I said before, the whole of the sewer is under high-water mark, but valves here (referring to the section) close against the tide. We do not admit sea water into it at all, except perhaps a certain amount which is always there, but speaking broadly, that is so. We have storm-water outlets in case of heavy rains, and of course, therefore, we have inlets as well, but these are protected by tidal valves. We burn coke here, and the amount it costs us is about 7*s.* per day. The height of our shaft is about 100 feet above the surface of the staircase, and the staircase itself is another 100 feet, making altogether 200 feet. Storm water brings air with it to a slight extent down the sewer. Before this intercepting sewer was made we had outfalls into the sea. Directly the storm water is sufficient to fill the sewer, the storm-water outlet comes into operation. We use sea water for flushing sometimes, but not very much; only occasionally. With regard to the staff we have to work this sewer, their wages altogether amount to 13*l.* 13*s.* per week. We have two men here, one night, and one day. Then as to the tide into which we discharge, the flow goes eastward you know, and the ebb-tide westward, six hours each way, the rise and fall of the tide being 20 feet, and the outflow of the sewer is closed for about six hours out of twelve. We get the permission of the owners of houses to use ventilating shafts in various ways. Some people who have good eligible places for shafts, will not allow us to utilise them on any terms, although it would be no injury to them. Other people, however, with broader views, come forward to do what they can for us. What I prefer to do is to get a regular flue about 14 inches square built up exactly like a chimney, with a pot at the top, so that nobody knows what it is.

(2.) *The Hove Sea Wall Works.*

Mr. Ellice-Clark, who acted as chaperone to the party, called the Members together in one of the sheds, and said: Gentlemen, perhaps it would be advisable to say in as few words as possible, the objects

of the work you are going to see. As I explained at the meeting this afternoon, the land at this part of the coast is defended from the encroachments of the sea naturally by the accretion of shingle. The whole of that shingle, we believe, travels from the west to the east, the prevailing winds being south-westerly. From various reasons, which I mentioned at the previous portion of the proceedings, we have had a bare place of shingle come in front of Hove. The method of holding up the shingle that has hitherto prevailed till this occasion has been that of placing groynes at right angles to the foreshore, which mechanically held up the shingle, preventing the foreshore from being denuded during rough weather. In consequence of this famine of beach about two years ago, it was considered advisable to do something more than put out more groynes; certain groynes which I put up, and which are still standing, are credited by some people with having caused the denudation of the foreshore instead of having increased the beach. However, this has got to be proved. A very bad place, almost immediately in front of where we are standing, having suffered very considerably from the south-westerly gales we have had, I recommended the Hove Commissioners to put up a wall. Feeling that they had already expended a large sum of money, some eight or ten thousand pounds, upon my advice, they sought the best advice they could get, and determined to call in Sir John Coode, as consulting engineer, to decide whether it was necessary to protect any part of this foreshore by a wall. Sir John Coode decided that not only was it necessary to put up a wall opposite this particular piece of foreshore where I had recommended it, but he advised the Hove Commissioners most emphatically to put up a wall along the entire length of their property, for neither a wall without groynes, nor groynes without a wall, would protect their foreshore. As the result of the report presented by Sir John Coode to the Hove Commissioners, after a great deal of discussion, that report was adopted, and to-day we propose to lay the foundation stone of a wall to stretch along the entire length of the Hove Commissioners' property. The wall will be composed entirely of concrete. The foundation of the wall will be at Ordnance datum, practically midway between high and low water. The process of determining the foundation level of the wall was this:—We sunk trial holes along the entire route of the proposed wall, to see whether we can get chalk on which to place the foundation. Chalk was found, but it varied from 28 to 30 feet below our coping, and Sir John

Coode decided that it was not necessary to go so low down, unless some great and unforeseen changes took place between the time of making these trial holes and the laying of the first block. There have been a succession of very heavy gales since those trial holes were made, and at the east end of the district the lawns, in which we naturally take considerable pride, have been carried away, and large sections of the foreshore have been taken away in every great gale. We thought it would be necessary perhaps, therefore, to carry the foundations of the wall lower than originally intended, and although I speak in Sir John Coode's presence, I have to say that we have not finally decided yet whether it is necessary to go a little lower or use a foundation of beach by which we can stand by our original scheme. If further heavy gales take place, and further denude the foreshore, we may, in some few cases, have to go a little lower, but we do not think it is necessary, except in such cases, to go beyond 8 feet 9 inches below the lowest recorded level of the shingle along the wall's route. . The face of the wall will be of concrete blocks, as you see in these sheds, faced with hand-picked washed flints, set 4 inches deep in neat cement, pointed to resemble the old Sussex church work. These blocks will be set in Flemish bond. Sir John attaches a great deal of importance to the closeness of the concrete, and therefore as you will see we have put a very considerable amount of sand into the concrete to fill up the voids. This concrete will be found to weigh about 127 lb. to the square foot. The back of the wall will be formed of concrete in mass; and I must tell you that the wall is emphatically to be a very stiff structure. It is to be 9 feet thick at the base, and 3 feet at the top, being 22 feet in height. The toe of the wall for the height of 3 feet is vertical, and then a slight batter begins. It will be coped with solid granite coping along its entire length. In two places along the wall there are slopes to the sea for the use of bathing-machines and carts coming to fetch away beach; and on top of these slopes are long safety platforms on which to stand bathing-machines in rough weather, and yet keep them out of the way of the broken water. The nose of the wall is 90 feet from, and parallel to the southern fence of the lawns. When the water comes over, as it is sure to do at some more exposed points, the waves will fall on a sort of deck composed of bituminous concrete, kept in position by a granite kerb supported by a granite channel, along which a great number of weirs discharge on the face of the wall, so that if the water comes over

the deck it will be discharged from weirs on to the face of the wall in the ordinary way. With regard to the cement, the whole of it is subjected to the ordinary tests. The whole of the cement is to be kept twenty-one days in store, and turned over twice before use; and the blocks are to be kept a month. The blocks are all dowelled, with joggles left, which will be filled in with very fine concrete, rammed as hard as it is possible to ram it. I do not know whether there are any more particulars, but if there are I shall be happy to give them.

Conducting the party round the sheds, Mr. Ellice-Clark continued:—Some may be interested in the way the 36,000 blocks we shall have to use are to be made, considering that the whole work is to be finished in a year's time, and to know the way in which the contractors have gone to work with all their temporary operations. One is pleased to see, as far as we have gone, the very able manner in which progress is being made by Messrs. Hill & Co., and their representatives, and although twelve months is an exceedingly short time in which to do this very heavy work, from the way in which it has been begun we have every reason to believe they will efficiently accomplish the task. These large blocks which are being moulded are to be placed in a continuous course of headers where the wall loses its vertical face and begins to batter. All these blocks through the entire course will be a course of headers right through the wall, and the other blocks you see are laid in the foundation course. All the blocks other than the kneelers are laid in Flemish bond, the concrete faced blocks are made all at one setting, pointing up and all. But I believe it is now time for us to repair to the stone laying.

Arrived at the works, and having made a cursory inspection,

Mr. J. W. Howlett (the Chairman of the Hove Commissioners) said: Gentlemen, it is not by any means with unmixed feelings of satisfaction that I witness this day. Five-and-twenty years ago, when I first came to live in Hove, we were proud not only of our lawns, but also of the unencumbered and ready access to our beach of shingle and sand. We felt then that we were much of a seaside village, and the place was often called at that time a village. We have grown now to be a large town, but I was fain to hope we should be able to keep one of the characteristics of a seaside village, namely, ready access to a smooth and pleasant beach. However, the Fates have willed it otherwise, and year by year we have seen these ugly groynes grow

up, in the end doing us a good deal of mischief. You have heard how it has all come about from Mr. Ellice-Clark, how we have been obliged at last to go upon another tack altogether. We (the Commissioners) struggled against it as long as we could; we discussed the matter over and over again, and at last we have been forced, acting upon the highest advice we could get, to incur, what all of us for the sake of the ratepayers of the town deeply regret we have been obliged to incur, I say, the very large expense involved in the erection of a sea wall, which will this day be commenced. But it is of no use looking, except for instruction, to the past. I do not regret at all, though there has been a great deal of discussion about it, the part which I have taken, and many others too. There has been a great conflict of opinion on the question of the protection of our foreshore. Out of every hundred men we meet, ninety-nine appear to consider themselves capable of giving an opinion on the question of sea-defences and groyning, and everyone's opinion differs from the others. Under these circumstances we went to the highest authority we could get, Sir John Coode, and to him we submitted the whole question. Well, he has gone into it most thoroughly, in conjunction with our very able surveyor, Mr. Ellice-Clark, and thoroughly thought out and worked out the scheme; and I have every confidence in them that what will be commenced this day will be brought to a successful conclusion, and that our foreshore will then be for all time effectually protected from further denudation. And while we have been obliged to take this step, yet it is very satisfactory to know that it will give us a magnificent promenade, one of the greatest ornaments to the town. With these few observations and wishing success to the work and the contractor—and I believe we have in our contractor one of the first men of the day for the work in hand—feeling confident that such a wish has every prospect of fulfilment, I now ask you to join with me in wishing the scheme "success."

Sir JOHN COODE: The Chairman of the Hove Commissioners has very unexpectedly called upon me to say a word or two on this occasion. It is a matter of no small satisfaction to me to be able to be present to-day. There has been in this case, as hinted at by Mr. Ellice-Clark, and by the Chairman, a great variety of opinion as to what ought to be done. My first duty was to point out to the Hove Commissioners the broad principles on which they should proceed. I found to a great extent the idea

prevalent that this work could be carried out successfully by means of groynes without a wall, and I had to advise them to carry out both or they could never look for successful results. In this case they were anxious to obtain a promenade, and I am bold to say they will in this scheme have a promenade which will be an ornament to the town, and I confidently believe a satisfaction to all concerned. I feel, too, in dealing with this work, there will be times and seasons when the wall will have to stand against no ordinary seas, and will have no ordinary amount of force to withstand, and I determined (as I recollect some of the Commissioners said to me that I should have to bear upon my shoulders the weight of all the responsibility in the matter), that this should be a sea wall which should be no discredit to the district nor to myself, and which should withstand seas not only in this next winter, or the one to follow, but such gales, too, as we meet with only some half-dozen times during a century, and with that feeling in my mind I sat down to devise and settle the main features that should govern this erection, and I was very ably seconded by Mr. Ellice-Clark. Mr. Clark has entered into so lengthy a description of the details that it is quite unnecessary for me to add anything further. You have seen the arrangements for making the concrete blocks are most complete, and the Chairman will now proceed to lay the first block of the work.

Mr. Howlett then descended to the foundations, and having been out of view for some little time, he was heard to say from the depths of the excavations, "I declare this stone well and truly laid."

Mr. W. Hill (of the firm of Contractors), addressing Mr. Howlett, said: I beg your acceptance, sir, of this case and the contents, and I hope the works when completed will be a permanent benefit to the town. He then handed Mr. Howlett a handsome case, containing a beautifully chased silver trowel with solid ivory handle, and an ebony mallet bound with silver, the trowel bearing the following inscription:—"Presented to J. W. Howlett, Esq., Chairman of the Hove Commissioners, on the occasion of laying the foundation in the new Sea Wall, March 15th, 1884. Sir John Coode and Mr. Ellice-Clark, Engineers. Mr. Charles A. Woolley, Town Clerk."

Mr. Howlett, on receiving this elegant memento of the ceremony, briefly replied: Thank you, and I hope this may prove a profit to you, and you will have no cause I trust to regret your contract.

The proceedings then terminated.

DISTRICT MEETING AT LEICESTER,

May 10, 1884.

Held at the Town Hall, Leicester,

Mr. W. H. White, *President, in the Chair.*

Mr. E. Pritchard, Past-President, intimated that he desired to be relieved of the duties of District Secretary, an office which he had held since the formation of the Association, but as it appeared to be the unanimous feeling of the Members that he should continue to hold this office, he consented to do so for another year, and he was then re-elected.

SOME OF THE PUBLIC WORKS OF LEICESTER.

By JOSEPH GORDON, M. Inst. C.E., Borough Surveyor.

If, in endeavouring to give some idea of some of the public works of Leicester, or rather, works carried out under the charge of the Corporation, and with which the Borough Surveyor, as their chief technical adviser, has more or less to do, the subject is not treated with that comprehensiveness which might under certain circumstances be desirable, it must be attributed to the difficulty of dealing with so large a subject within the limits of a paper, and rather to the desire of the author to present to the Members of the Association a more general idea of the work of a Corporation of an increasing and prosperous manufacturing town such as Leicester may, notwithstanding the general depression of trade during the past three years, be fairly said to be.

Population.

The population of	Leicester	on the	1st April	in the year	1851	was 60,584
,,	,,	,,	,,		1861	,, 68,052
,,	,,	,,	,,		1871	,, 95,220
,,	,,	,,	,,		1881	,, 122,351
,,	,,	,,	,,		1884	,, 132,000

It will be seen from this, that the rate of increase was 39·9 per cent. from 1861 to 1871, which is the greatest percentage of increase of any of the twenty largest towns of the United Kingdom for that period. From 1871 to 1881 the rate of increase was 28·5 per cent., a rate of increase exceeded during that period only by the towns of Salford, Oldham, and Nottingham, the more rapid increase of Salford being accounted for by the stationary condition or decrease of Manchester, and in the case of Nottingham by an extension of the boundaries of the borough. Taking the two decades from 1861 to 1881, Leicester still heads the list of the large towns of the kingdom, with an increase during the period of twenty years of 79·8 per cent., Salford and Bradford coming next with 72 and 70·8 respectively.

Streets, Roads, and Footways.

In a paper read before a similar District Meeting of the Association, held in Leicester on March 24th, 1874, by the late Borough Surveyor (Mr. Stephens), the area of Leicester was stated to be 1000 acres, the population 105,000, the number of streets 450, and their total length 45 miles. The area actually built upon at the present time is 1300 acres and the area within the borough boundaries 3030 acres. Taking the present population at 132,000, and the acreage built upon as above, the average density of population is 101 per acre, a density which cannot but be considered high when compared with the density of population of London of 53 persons per acre as comprised within the area of the Metropolitan Water Companies, as recently set forth in the opening address of Sir Joseph Bazalgette before the Institution of Civil Engineers, and approaching more to that of Paris with its 111 persons per acre.

The number of streets is now 621, and their total length 71·65 miles, made up as follows:—

	Miles.	Miles.
Private and unadopted paved streets	4·94	
„ „ macadam roads	6·20	
		11·14
Paved streets repairable at public expense ..	46·27	
Macadam „ „ „ ..	13·20	
Tar macadam „ „ „ ..	1·04	
		60·51
Total miles		71·65

During the past three years, in addition to the ordinary and frequently extensive repairs and maintenance of the above roads

and streets, several streets have been paved with granite 5 in. by 3 in. setts, on a concrete foundation and grouted in with pitch and tar. Several new streets, both public and private, have also been formed and paved in the same manner, and numbers of other new streets have been formed with granite random setts, whilst others have been formed as macadam roads.

The length and area of the carriageways of such streets and roads is as under:—

	Length.	Area of Roadway.
Public	3149 lineal yards,	28,176 square yards.
Private	1267 „	8,448 „

During the same period notices have been served on owners to pave or repave, sewer, and properly form numbers of unadopted streets, and the work has with one exception, and excluding sewers, which were generally let by contract, been done by the Corporation workmen, and the expenses apportioned to the owners.

The length of streets put into a proper state of repair and adopted in this way amounts to 9501 yards, 8005 yards of which were paved streets and 1496 yards macadam roads.

It may be interesting to note here that during the past three years a fair trial has been given to tar macadam for the roadways of various streets in the town, and tar paving has also been extensively used for the footways of a suburban character and for side streets, the work being now done by a staff of workmen in the employ of the Corporation. What may be termed an artificial asphalte has also been tried for the footways during the past two years, and which bids fair, now, in its improved and more perfected form, to rival in appearance and durability, the best rock asphalte, but at a much less cost than the latter. The work done by this staff of workmen during the past three years, and the average cost thereof, is as follows:—

			s.	d.	
Tar macadam	14,251 sq. yds.,	average cost	2	9¼	per sq. yd.
Tar paving	22,567 „	„	1	4	„
Artificial asphalte ..	5,084 „	„	3	4	„

At the same time the following new causeways have been formed in other materials:—

	Square yards.	Average cost. s.	d.	
3 in. by 3 in. granite cubes	15,867 ..	4	10	per sq. yard.
Rock asphalte	619 ..	5	3	„
York flagging	6,478 ..	6	9	„
Victoria stone or concrete flagging ..	150 ..	4	6	„

The kerbing for these footways is all granite, either 10 inches

or 12 inches deep, 6 inches broad on the top, and as a rule with an inch chamfer to the depth of the channel, to prevent the grinding of the wheels of vehicles against the arris of the kerb. Nineteen and-a-half miles of kerbing have been laid down during the past three years.

Various street improvements, for which purchases of property have had to be made, have also been carried out during the same period.

The expenditure of the Highway Department for the works described, including cost of storm sewers, defrayed out of current rates, and the working expenses of the sewage precipitation works, has been on the average for the three years under review at the following rates per annum:—

	£
1 Roadways and footways, including watering and scavenging of streets	18,168
2 Street improvements	3,102
3 Sewer cleansing and improvements 4 Storm sewers, exclusive of those paid for out of loans	3,690
5 Sewerage purification works, working expenses, after deducting 30*l.* receipts	2,000
6 Sundries	90
	£27,050

The average annual expenditure of the Sanitary Committee, under the Night Soil Department, in emptying privies, dustpits, and pails, and dealing therewith, is as under:—

	£
1 Emptying of privies, dustpits, and pails	8,988
2 New urinals and repairs	243
3 New stabling, repairs, and alterations	542
4 Horses	390
5 Disinfection	48
6 Bathing places	573
	£10,784

Against which the sale of manure realises about 3362*l.*, and there is an income of about 50*l.* from the open air baths.

The number of workmen employed by the Highway and Sanitary Departments, amounts to 265.

Building Trade.

The activity of the building trade has fallen, during the period referred to, considerably short of previous years, but this may be attributed to the depression of trade generally, rather than to

any action of the Local Authority, although no doubt for a time the introduction of more stringent building regulations, under an Improvement Act introduced into Parliament in 1880 and sanctioned in 1881, may have checked the speculative character of building operations in the erection of cottages, and even a higher class of property, with 4½ inch party or division walls between them, a minimum thickness of 9 inches being now required.

Plans have been submitted and approved of by the Highway and Sewerage Committee as follows:—

	1881.	1882.	1883.
New houses	558	420	201
Additions and alterations	304	320	261
Shop fronts	56	33	17
Sheds, stables, and workshops	70	73	64
Warehouses and factories	13	11	13
Schools and chapels	4	4	2
Coffee-houses	1	1	1
Mission and memorial halls	2	2	4
Offices and special buildings	6	5	3
New streets	4	1	1
Sewers and culverts	2	0	0
Drainage	16	29	32
	1036	899	599

The Sewerage of the Town.

The late Borough Surveyor on the former visit of the Association in March 1874, described the general features of the sewerage of Leicester, and more particularly the sewage pumping and purifying works; the author does not purpose therefore travelling over the same ground, but rather to give the Members assembled a general notion of the difficulties which the rapid increase of a town brings with it in dealing with so important a work as the drainage of a town must always be, and more particularly in the case of a town like Leicester, suffering originally from somewhat difficult physical features of the district, lowness of position of the more thickly populated parts of the district, and having, instead of a river with a large volume of water and moderate velocity, only stagnant elongated ponds formed by the locks of the navigable river and canal, into which any effluent water from sewage works, on whatever principle the sewage may be dealt with, must eventually find its way. In the former paper the system was described as a duplicate one, that is, all the old original shallow sewers having

numberless outlets into the nearest streams, were retained as surface-water sewers at the time a new system of deep sewers was laid down in 1853 and 1854, connections being made between the former and the latter of such a character that any sewage finding its way into the old sewers would pass to the new deep sewers at ordinary times, while storm waters would pass to the river and canal, the ordinary sewage being so diluted at such times that no harm could arise to the streams into which these sewers emptied themselves.

The author has no hesitation in saying that in his opinion it is not desirable to deal with old sewers in this way. They may in many instances be utilised as surface-water sewers, but they should be ascertained to be in good condition before being adopted, and above all they should never be adopted excepting their course is in the public streets and thoroughfares. There may be exceptional cases of adoption, but old sewers or culverts, which are frequently simply old open ditches covered over as each owner has found it necessary in the erection of buildings, should never be adopted as part of a system when they pass at the rear of private properties, and even sometimes under the houses, as many now do in Leicester; and it is certainly fraught with danger to allow any existing foul water drainage from buildings and premises to continue to pass into them. Wherever old sewers are capable of adoption as storm-water sewers, or as relief overflows to the deep sewers, all foul water drainage connections should be severed from them. There are about 12 miles of such old sewers existing in Leicester, and there are 64 miles of deep sewers, 9½ miles of which are main trunk sewers, and including 11 miles of branch sewers in unadopted streets. In addition to these, since 1878, 15 miles of main and branch storm-water sewers, upon which about 16,700*l.* have been expended, have been carried out. Prior to 1881 the ventilation of the sewers was partly by open gratings in the street, but altogether inadequate in number, and more particularly by connections with about twenty-three factory chimneys, as well as by means of the rain-water pipes of high buildings. The connections with the factory chimneys have as a rule been made with the private drains of the premises to which the chimneys are attached. It is evident therefore that a connection of this kind will not be so effective at the moment of the greatest pressure of sewer gas as an independent connection with a chimney from the crown of a public sewer would be, because in the first place when the sewer is being

filled with water in a rainfall, and the air within it under compression is being driven back to force the traps within the houses, the mouth of the drain connection with the chimney will be closed and ineffective. A considerable number of chimney connections is now being made, but wherever practicable the connections are carried independently from vertical shafts brought up from the sewers, as shown by a drawing upon the walls.

The author, under the directions of the Highway and Sewerage Committee and the Sanitary Committee, commenced in 1881 a systematic opening out and cleansing of the main trunk deep sewers, more particularly in the low-lying districts, chiefly under the influence of a backwater to the extent of from 8 to 9 feet for considerable periods prior to the increase of pumping power at the sewage works. This had naturally resulted in the silting up of the sewers to a great extent, but the cleansing operations were impracticable until the engine-power was increased, and difficult even then for want of accessible manhole shafts, and in consequence of the size of the sewers not being sufficient, excepting in one or two cases, to admit workmen into them.

Since May 1881, when this work was commenced, 24,211 yards or 13·75 miles of sewers have been opened out and thoroughly cleansed, and provided with proper manhole or inspection shafts and ventilating shafts or open surface gratings; 1325 shafts had to be sunk down to the sewers for this purpose, varying in depth from 8 feet to 34 feet; on the whole of this length of sewers there were only 18 inspection shafts with surface gratings brought up to the surface; 118 old brick shafts covered with slabs five or six feet below the ground have been brought to the surface and finished as manholes with open gratings; 131 entirely new manholes, and 245 new ventilating shafts, both with open gratings which in all cases are provided with dirt-boxes beneath, have in addition to the utilisation of the old shafts been constructed, making a total of 267 manhole ventilating shafts and 245 lamphole ventilating shafts, being a surface ventilator for every 47 yards, or about 37 to the mile.

That the introduction of so large a number of open ventilators was likely to meet some opposition, and that there should be diversity of opinion thereon, was not more than might be expected, and for the guidance of others who may have to deal with so old a system as that of Leicester, it is only right to state that various complaints have arisen of particular ventilators being a nuisance at

particular times. This is, perhaps, not surprising on considering the not very satisfactory condition of some of the sewers, but more particularly from the fluctuating temperature of the air within them in the vicinity of large manufactories passing water of high temperature, and often highly charged with steam, into them, so that not infrequently steam may be seen issuing from the gratings.

In such cases it is evident that it becomes to some extent inconvenient to vehicular traffic, and that it is necessary to close such ventilators by a zinc plate under the grating. In these cases the permission of an adjoining owner is generally obtained to carry from the underside of the manhole cover a pipe to the eaves or ridge of the nearest high building. The author is, however, of opinion that, in a properly constructed system of sewers, kept in good order by flushing arrangements, and with proper regulations as to the temperature of water to be admitted, as demonstrated in several cities within his own experience, it ought not to be necessary to close any of the surface gratings, and that the more numerous they are, the better. The large number of gratings already introduced in Leicester has undoubtedly relieved the sewers and house drainage of a dangerous pressure of sewer gas, and there can be little doubt that as they are multiplied and aided by high shafts and factory chimneys, so as to convert them as much as possible into intake shafts, insuring a constant current of atmospheric air through the sewers, the better it will be for the health of the town. Dr. Johnston, the medical officer, is clearly also of this opinion, for he has taken great interest in this work, and has incorporated into two of his reports the full details of the work carried out in 1881 and 1882. And although it would be unfair to assume that the steady reduction of the rate of mortality in Leicester is due in a great measure to the sanitary improvement works of a structural character of the Corporation executed during the period dealt with, the doctor is evidently of opinion that, together with the nuisance removal orders of the Sanitary Committee and other stringent measures of precaution against the spread of infectious diseases, they have contributed their due share towards so satisfactory a result. The mortality in 1880 prior to the execution of the works described was 24·67 per thousand. In 1881 it fell to 21·56; in 1882 to 20·03; and in 1883 to 19·31, a rate of mortality lower than has been recorded in Leicester at any previous period, as will be seen by the annexed table of the rate of mortality from 1845 up to the present time. The year 1883 was no doubt

an exceptionally healthy year for the whole country, but the fact remains that at no previous period can three years be found where such a favourable mortality bill can be shown.

BOROUGH OF LEICESTER.

TABLE SHOWING CORRECTED POPULATION AND RATES OF MORTALITY FROM 1845 TO 1883.

Year.	Population, 30th June each year.	Rate of Mortality.	Remarks.	Year.	Population, 30th June each year.	Rate of Mortality.	Remarks.
1845	55,404	29·67		1867	85,040	24·92	
1846	56,382	30·84					Epidemic measles and diarrhœa.
1847	57,360	..		1868	87,757	28·57	
1848	58,338	..					
1849	59,315	28·34		1869	90,473	25·94	
1850	60,293	23·45					Epidemic scarlatina and diarrhœa.
1851	61,271	25·20		1870	93,190	27·87	
1852	62,018	27·94					
1853	62,765	26·77		1871	95,907	26·80	
1854	63,511	24·88		1872	98,620	26·85	
1855	64,258	23·31		1873	101,333	23·69	
1856	65,005	21·71					Lowest of all manufacturing towns.
1857	65,752	28·06		1874	104,046	24·06	
1858	66,499	29·16					
1859	67,245	24·51					Epidemic scarlatina.
1860	67,992	20·85		1875	106,759	27·06	
1861	68,739	25·97		1876	109,473	23·37	
1862	71,456	24·07		1877	112,186	22·42	
			Severe	1878	114,899	21·76	
1863	74,173	30·32	scarlatina, measles, and diarrhœa.	1879	117,612	22·54	
				1880	120,325	24·67	
				1881	123,120	21·56	
1864	76,889	27·48		1882	126,275	20·03	
1865	79,606	25·56		1883	129,483	19·31	
1866	82,323	23·63		1884	..	..	

Capacity of Original Sewers.

A reference to the population of Leicester as set forth at the outset, shows that it numbered only 60,584 at the time the original sewers were about to be constructed, and that the population has considerably more than doubled itself since then. It follows from this that the area of paved roads, yards, and slated roofs must have increased in still greater ratio, delivering in times of rain a volume of water to the sewers never contemplated by the engineer of the original works, the late Mr. Thos. Wickstead.

Originally a very large margin was allowed for sewage and waste water from manufactories, viz. 25 million gallons per day of 24 hours, but only for three-eighths of an inch of rainfall in addition thereto in the same time.

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The quantity of sewage, waste water from manufactories, and a large amount of subsoil drainage which finds its way into the sewers, has never exceeded 10 million gallons, and this is only reached when the river is flooded or backed up above its ordinary level. The present or ordinary flow may be taken at about 8 million gallons, being equal to about 60 gallons per head of the population. Undoubtedly, however, about two-thirds of this is due to subsoil drainage, so that the sewage to be dealt with is greatly diluted. While therefore there is a greater margin for rain-water than originally intended, it is quite clear that as the town developed itself in all directions so rapidly, the deep sewers would become more and more inadequate in times of heavy rainfall, and that they would be gorged and put under pressure, and that this would increase in intensity every year, producing considerable inconvenience by inundating the cellars in the low-lying districts having drainage connections with the sewers.

To meet this difficulty the late Borough Surveyor proposed a system of new storm sewers, for which a loan of 12,000*l.* was obtained in 1878, but this included chiefly main trunk sewers, which it is evident would only effectually relieve the deep sewers, if laid at such a sufficient depth as to be capable of being used as overflows for them, or that if laid at shallow depths branch duplicate sewers must be constructed in every street to catch up and conduct to the main trunks all the surface water capable of being diverted from the deep sewers in this way. The main trunks having been laid at shallow depths, the latter course has had to be adopted with the view of utilising the works already executed.

From 1878 to 1880, 4773 yards of main trunk storm sewers, including some minor branches, were carried out at a cost of 6743*l.* In 1881, 1882, and 1883, 21,627 yards of sewers in connection with the above have been executed at a cost of 9963*l.*, making a total of 15 miles of new storm sewers, and an expenditure of 16,706*l.* up to the present time. Independently, therefore, of the main trunk sewers, three districts have been provided with as complete a system of duplicate sewers as it is possible to conceive short of requiring a duplicate system of drains for each house, which, retrospectively, would be next to impracticable, even if at all advisable. The last of the districts referred to has just been completed, or is practically so, with the exception of the connection of a number of street gullies. Before, however,

proceeding with other districts, the Highway Committee has very properly called upon the author for a report on the whole subject, as it has become evident that if the system of duplicate sewers is to be extended to the whole town, increased borrowing powers will have to be obtained, and that before deciding to seek such powers the Committee should not only know from the experience of what has been done to what extent the deep sewers will be relieved by a complete duplicate system, but also the entire cost involved, in order that they may judge as to whether the advantages to be derived are commensurate with the cost.

The author regrets that although his plans in connection with this subject are far advanced, he is unable to communicate his views to the Association until they have been before the Corporation.

Flood Prevention Works.

The town of Leicester has suffered for a very long time past from the flooding of the surface of the streets, in the lower portions of the town, and entire districts thickly populated chiefly by the working classes have, from time to time, been inundated; but the several mill-owners along the line of the river Soar, and the canals passing through the town, have also been large sufferers through their mills being flooded and large and valuable stocks of goods being damaged or spoiled, to say nothing of the number of hands thrown out of work during the inundations, and the sickness and loss of health resulting from the occupancy of the flooded dwellings, being for months afterwards damp and a source of danger. The immediate danger has been met as promptly as circumstances would admit of by the cleansing of the cellars and ground floors of the dwellings, and removal of mud and filth left behind on the subsidence of the waters, and by the use of disinfectants, but it is not to be wondered at that before much can be done the health of the occupants of the flooded houses has suffered. That the constant recurrence of such inundations has given rise to loud complaints, and been followed in each case by public meetings urging the Corporation to adopt comprehensive measures of relief, is only what might naturally be expected to occur on the part of the inhabitants of any district subject to such inundations.

The Corporation have in fact had the subject before them from time to time for the past thirty years. The first report was made

to them in November 1853, by Messrs. Crossley and Foxton, and this report was reprinted in 1861 and again in 1867. In 1869 Messrs. Hawkshaw and Hawksley reported on the subject, and the late Borough Surveyor reported thereon in 1872.

Acts of Parliament were obtained in 1868, 1874, and 1876 for dealing with the lower reaches of the river, and the sum of about 124,400*l.* has been expended in dealing with the river from a weir constructed in 1875 at Messrs. Evans' mill to the Belgrave Mill, a distance of 130 chains, and in dealing with the canal from the Lime Kiln Wharf also to the Belgrave Mill, a distance of 70 chains, including the lowering of the Willow Brook from the Lime Kiln Lock to the Midland Railway, a distance of 60 chains, in connection with which latter work a new bye-pass for a distance of 220 lineal yards through Wood street and an additional tunnel 100 yards long under the Midland Railway had to be constructed.

The first works undertaken under the 1868 Act, namely the widening of the Swans' Nest Grass Weir, the construction of sluice gates and cutting of a new channel from Swans' Nest Weir to the Belgrave Mill; a weir at Evans' Mill and a new flood river channel to Hitchcock's Weir and widening of the river beyond, towards Thompson's Factory, have since proved inadequate, and another new weir and further widening of the river between Evans' Weir and the north bridge are now in course of construction under an Act of Parliament obtained in 1881, while a new stone weir has taken the place of the Swans' Nest Grass Weir and the river has been farther widened between it and the Belgrave Mill under the 1874 Act.

The works executed under the 1874 and 1876 Acts are of an extensive nature, consisting of a practically new river channel varying from 80 to 90 feet bottom width, with pitched slopes 2 to 1, and in the lower reach with extra flood slopes giving an increased width of 45 feet of river in floods. From Evans' Weir to the new weir, which has been constructed at the Abbey Corner in connection with the new park, the water has been lowered 3 feet 6 inches. From this latter weir, to the Swans' Nest New Weir, constructed at Belgrave, the water has also been lowered 3 feet 6 inches. The works have been carried beyond the borough boundary to the Belgrave Mill, where a new towing-path bridge of 100 feet span across the river has been erected.

Starting back from the Swans' Nest New Weir, where a new lock has been constructed at a lower level, a new channel has been cut

for the canal until the old line of canal is intersected, which has been regulated, widened and deepened, and is practically a new canal at a 3 feet 6 inches lower level for a distance of 70 chains up to the Lime Kiln Wharf, where another new lock of 3 feet 6 inches lift has been constructed.

In connection with these works a new road 1000 yards long has been constructed from what was formerly called Sidney Street (but now the Abbey Park Road), right across the Abbey Meadow, and along by the old Abbey wall to the Abbey Lane. Two bridges have had to be constructed for this road, one across the canal, of 45 feet span and 30 feet between the parapets, and the other across the river, of three spans, viz. two of 30 feet and one of 40 feet, also with 30 feet width between the parapets.

The road along the Abbey wall, and at the other end from Belgrave Road to the first bridge, is 40 feet in width, but between the bridges along the whole length of the park it is 50 feet in width. These works were originally designed by Mr. Stephens, the late Borough Surveyor, and the detailed plans worked out by Mr. Hewit, C.E., under Mr. Stephens' directions. The execution of the works was eventually entrusted to Mr. Griffith, C.E., and have been carried through by him under the directions of the Flood Works Sub-Committee, with the exception of the formation of the road between the Belgrave Road and the Abbey Lane, which was carried out under the directions of the author by Corporation workmen. The works carried out under the 1868 Act were executed by Messrs. Smart and Thumb, of Nottingham, and Mr. John Lea, of Leicester, carried out the new weir at Evans' mill and flood channel in connection therewith under the 1874 Act.

Messrs. Benton and Woodiwiss, Contractors, of Derby, executed the works on the river between the North Bridge and Belgrave Mill, including the weir in connection with the park, the new bridges at the Abbey Corner, and across the canal, also the Swans' Nest New Weir and canal lock in connection therewith. The towing-path bridge at Belgrave was erected by Messrs. Richards and Sons, of Leicester. Messrs. Whittaker Bros., Contractors, of Leeds, carried out the canal works, including the new lock at the Lime Kiln Wharf.

The new park has been formed upon about 68 acres of the Abbey Meadow, which was subject to constant flooding, but was drained by the lowering of the weirage, while the surplus soil arising from the river excavations was used to form embankments

round the park, and also to form mounds and undulations to give artistic effect to the design of the landscape gardeners, Messrs. Barron and Sons, of Elvaston, Borrowash, near Derby, who obtained the premium awarded for the best plans of the park in a public competition, and were intrusted with the superintendence of its laying out and construction, and with the planting of the whole.

The draining, formation of the roads, and other earth works were carried out by workmen in the employ of the Corporation, under the directions of Mr. Griffith and Messrs. Barron, and the lodges and pavilion were erected from the designs and under the directions of Mr. Tait, Architect, of Leicester. The total cost of the park works was about 29,600*l.* exclusive of land.

The new road 520 yards long, from Slater Street to the western entrance, was constructed under the direction of the author by Corporation workmen, under great pressure in order to be ready for the opening of the park by their Royal Highnesses the Prince and Princess of Wales in May 1882.

The whole of what is called St. Margaret's Pasture, across which this road runs, has been raised to the level of the new road since, with the view to its use as a recreation ground. A new bridge has also been constructed by Messrs. Shaw and Co., of London, across the canal, 40 feet in width between the parapets, together with improved approaches from Pasture Lane and Lower Church Gate, under the directions of the author. The expenditure upon the Abbey Park Road, Slater Street extension, Pasture Lane Bridge and approaches not included in the previously mentioned sum, amounts to about 6000*l.*

Works now in Progress.

An extraordinary flood having occurred in July 1880, which flooded about 422 acres of land and streets in the upper reaches of the river above the point to which the River Improvement Works had been carried, the Highway Committee instructed Mr. Griffith to report upon the best means of preventing future flooding. He reported on 23rd August, 1880, and his report was then submitted to Mr. Hawksley, who approved it generally with some modifications. A Bill was then deposited in Parliament under the advice of Mr. Hawksley and on the authority of Mr. Griffith with regard to the cost of the work proposed to be carried out. The Bill received the sanction of Parliament in July 1881. The author

had in the meantime taken office as borough surveyor and under the obligation to take charge of these works in addition to his other official duties, but as nothing farther than parliamentary plans had been prepared, nothing could be done until a complete survey on a large scale and detail plans had been prepared, which owing to the greater intricacies of the work and interests involved was likely to occupy some time. Some of the works under the former Acts, more especially the Canal and Willow Brook Works, and the formation of the park, were then in full swing, and great efforts being made to get the latter ready for opening in May 1882.

Little progress was therefore made with the preparation of plans for the new flood works until the author was requested to report on the condition or state thereof, when he recommended increased assistance to push them forward. Towards the end of 1882 some time was also lost by an alternative scheme being again revived, and the author requested to report thereon, and on the probable efficiency of the parliamentary scheme generally.

A commencement was made in July 1882 by the lowering of the North Lock, the contract for which with towing-path wall in connection therewith was let to Messrs. Whittaker. The Castle Mill Lock was also lowered at the same time to enable the canal traffic to be carried on when the water is lowered in the town pond to the proposed level of the new weirs. The next contract was let to Messrs. Kellett and Bentley, in April 1883, for 13,990*l.* Farther works have since been let to them, bringing up the value of the works undertaken by them to 19,660*l.* In connection with this section the ironwork of the towing-path bridge across the new weir and the entrance to Mr. Hitchcock's basin was let to the Bridge and Roofing Co., of Darlaston, for 849*l.* Soon after Messrs. Kellett and Bentley's contract was commenced, the two-span bridge erected in 1875 over the flood course at Soar Lane as a roadway bridge to the Midland Railway goods and coal wharf, was washed down or rendered so dangerous by the effects of a flood which occurred in 1882, that the portions of it left standing had to be taken down. Under the Act of 1881 it was intended to add another span to this bridge, but this calamity rendered it necessary to build an entirely new bridge of three spans, and the case being pressing a separate contract was advertised, Messrs. Kellett and Bentley being again the successful contractors. In the meantime the traffic had to be carried on across the adjoining railway bridge. The addition to this latter bridge with retaining walls and invert-

ing of the river bed in connection therewith was also let to Messrs. Kellett and Bentley.

This section of the work embraces, in addition to the bridge work mentioned, the widening of the flood course for a distance of 533 lineal yards between the Soar Lane Bridges and the North Bridge from the original width of 45 feet to a width of 75 feet and 95 feet, the necessary land for the purpose having been obtained from Lord Dysart on the north side and from Mr. Hitchcock on the south side.

The slopes of the river channel are pitched with rough-dressed granite pitching 12 inches deep, set with blue lias lime to a height of 3 feet 6 inches above the water level, or 6 feet 6 inches above the bed of the river, the remainder of the slope being turfed. The slope is 2 to 1 on the north side, and on the south $1\frac{1}{4}$ to 1 along the Midland Railway Co.'s wharf, varying along Mr. Hitchcock's garden from a battered wall to a slope of $1\frac{1}{2}$ to 1. Beyond this, along the land of the Trustees of the late Mr. Abell, the slope is 2 to 1. In Mr. Hitchcock's garden, as will be seen from the plans, two bays or arms of the river, the one forming the overflow from the old weir and the other from four flood gates, widen out towards the present line of the river, and were washed into deep holes, so that the intended pitched slope across these bays had in reality to be made more of the character of a strong retaining wall with a stiff batter, and this had to be continued in a modified form all along these premises, as the intervening ground was found to be all made ground of a somewhat treacherous character. The backing up of this pitching, which in this case is carried up to the ground level, consists of lias lime concrete, and is, as will be seen from the cross-sections, of considerable thickness.

Near to the North Bridge the whole of the works of Messrs. Thompson had to be underpinned for a depth of 5 feet. Those of Messrs. Hawley, Mr. Hollingworth, and Mr. Forsell had also to be underpinned along the Tail Race of the North Mill, and a new retaining wall and brick invert had to be constructed in connection therewith, owing to the immense scour of the water in a flood over a weir which had to be constructed between the higher and lower levels of this race having undermined the foundations.

The new weir constructed at the west end of Mr. Hitchcock's garden is intended to pass the flood waters flowing past the weir higher up the river and through the bridge of the railway company along the canal towards the North Lock, and will act as an auxiliary to the weir at Evans' mill. It consists of four spans each of 50

feet in the clear, with ashlar piers to carry the wrought-iron towing-path bridge over it, and will pass 130,674 cubic feet per minute with a head of 2 feet of water on the crest, notwithstanding that it is calculated that the latter will be drowned to the extent of about a foot in an extreme flood. The fall from the crest of the weir to the water below at summer level is 5 feet 5 inches, the depth of water on the low side being 3 feet, and on the high side 5 feet 6 inches. The foundation and body of the weir consist of cement concrete in the proportion of 9 to 1 and 6 to 1, faced with Derbyshire ashlar blocking, the crest stone being granite, hammer-dressed, 3 feet 6 inches wide and 1 foot 6 inches deep. The bed of the river for the whole width of 100 feet opposite this weir, from the toe stone of the weir to the opposite bank, consists of cement concrete varying in thickness from 2 feet 6 inches to 1 foot 6 inches, and forms therefore an extended apron to the weir. This was found to be necessary owing to the bed of the river consisting of gravel at the level at which it had to be formed.

At the east end of the weir a new basin has been formed for Mr. Hitchcock, of the North Mill, the old and irregular form of the basin having been abandoned at the request of that gentleman, who contributes the increased cost involved. The new walls of this basin are constructed of lias lime concrete faced with brindle brick. The entrance to it from the canal is spanned by a wrought-iron bridge of 70 feet span in continuation of the towing-path, and so as to give a clear headway of 8 feet for boats and barges passing into the basin.

Between Soar Lane and the North Lock the canal has been widened and deepened, with the object of giving increased sectional area and lowering the water to an extent of 1 foot 10½ inches. The depth of water at the lower level will be 5 feet 6 inches, although the original depth was not more than 4 feet 2 inches, so that the bed of the canal has been lowered about 3 feet 4 inches. The increased sectional area thus gained and the lowered level of the water will, it is anticipated, fully prevent future overflowing of the river and flooding of the district.

New towing-path walls have been constructed throughout the whole of this length, consisting of cement concrete, the length between Soar Lane and the new weir being faced with brindle brick, and that between Hitchcock's basin and the North Lock being floated and rendered with cement and lined.

On the opposite side, along the Midland Railway Co.'s wharf,

a similar wall has been constructed, but of lias lime concrete, all these walls being coped with a heavy ashlar coping.

Heavy underpinning works and new retaining walls had to be executed in connection with Messrs. Collier and Messrs. Bowmar's premises adjoining the North Lock. New intakes and water-supply works, consisting of wells and settling tanks, had also to be carried out in connection with these works, and similar works have had to be executed for Mr. Hitchcock, including in this case the laying of a 12-inch pipe from the river to, and construction of a new well in the centre of his ground.

The next contract was let in September last, to Messrs. Pilling and Co., of Manchester, and was for that section of the works between Soar Lane and the West Bridge on the one hand, and the Braunstone Gate Bridge on the other, amounting to 28,000*l*., but to which other works have been added since, bringing the present amount up to about 30,000*l*.

This contract includes the widening and deepening of the Leicester Navigation from the Soar Lane to the West Bridge; and the widening and deepening of the river Soar from its junction with the Leicester Navigation to the Braunstone Gate Bridge, and all works in connection therewith. It embraces the following works, viz.:—

1. The underpinning of the whole of the buildings abutting on the river Soar between the Braunstone Gate Bridge and the eastern corner of Messrs. Turner's factory, together with such new retaining walls as may be required along the route.

2. The providing of an additional flood arch at the Bow Bridge.

3. The diversion of the river in an oblique direction by means of two covered outlets, or tunnels, each of 22 feet span, for a length of 220 feet, under the Midland Railway, in lieu of the present wooden structure, which is almost at right angles to the canal and railway, and which has caused such serious obstruction to the flow of water in the past.

4. The widening of the river between the Bow Bridge and the above outlet on land taken from the railway company, and the construction along such length of a heavy retaining wall with a protecting railing along the top thereof.

5. The widening and deepening of the canal from the West Bridge to Soar Lane. The land required for these works is taken from the Midland Railway Co.'s West Bridge Station at great cost.

6. A new towing-path wall now being constructed from the

West Bridge to Evans' Weir, beyond which, for a length of 110 yards to Soar Lane Bridge, the height of the retaining wall is 16 feet above the bed of the river and will be protected by an iron railing.

On the opposite or east side of the river various new river walls have been constructed and a considerable amount of difficult underpinning of buildings has been completed, but there is still a great quantity of this class of work yet to be done. For a length of 120 feet at the back of houses in All Saints' Road and All Saints' Place, it was thought advisable to take down the outhouses, in the shape of wash-houses, water-closets, and ashpits, resting on the river wall, and to rebuild them after a new retaining wall had been built, rather than attempt to underpin the old wall and buildings.

The new weir at Evans' mill will consist of six bays or spans, each 50 feet in the clear, with piers between them to carry a wrought-iron towing-path bridge. This weir will, therefore, with a head of 2 feet 6 inches of water on it, acting as a drowned weir, as in the case of the weir near Mr. Hitchcock's basin, in time of flood discharge 260,793 cubic feet per minute without the aid of flood-gates. Four sets of flood-gates are, however, to be placed in this weir, each 6 feet broad by 5 feet 7 inches in height. Two of them will be placed in the bay next the Midland wharf, and two in the third bay from the eastern abutment.

Part of the outhouses of Evans' mill will be taken to give a better water-way for this weir, and land at the eastern end of the weir, which could not be utilised for weir purposes, will be given up in exchange. The weir and the towing-path and retaining walls are of similar construction to those previously described.

The underpinning has in all cases been done with brickwork in Portland cement, and faced with brindle bricks to the height of the water-line. The entire bed of the river between the toe of the weir to and through the Soar Lane Bridges will be lined with 9 inches of brickwork in cement on a bed of 15 inches of lias lime concrete, the finishing ring of brickwork being brindle brick. There are 4879 square yards of this class of work below this weir, forming one continuous apron through the bridges.

In widening the canal above the weir, part of the old station, and more particularly a portion of the original board-room and birth-place, it may be said, of the Midland Railway Company, had to be demolished, together with stabling and storage buildings, while for

the diversion of the river Soar under the railway, cottages and other stabling were acquired and removed.

The total expenditure upon these works up to the present time, including engagements under the existing contracts to complete the works to the West and Braunstone Gate Bridges, and including the purchase of land and buildings, expenses of obtaining the Act, and engineering, will be about 71,000*l.*

Upper Reach.

The works not yet let, and for which farther borrowing powers have had to be sought, and the detail plans of which are now being prepared, consist of making an entirely new river channel about a mile long in lieu of the present canal from the West Bridge to the viaduct of the Burton Branch of the Midland Railway, and of widening and deepening the river Soar for a length of 1050 yards from the Braunstone Gate Bridge to the junction with the aforesaid new river channel at a point near the present bathing station. The present water level of the canal commencing at the North Lock will be lowered 1 foot 10½ inches to the Castle weir and lock, both of which will be done away with entirely, and the water above this point lowered to the extent of 4 feet 10 inches for a distance of 483 yards up to the Swans' Mill Lock, which will also be done away with, and the level of the water in the canal lowered to the extent of 7 feet 6 inches from this point upwards for a distance of 1000 yards to a new weir and lock with a lift of 7 feet 6 inches, to be constructed at about 130 yards from, and below the railway viaduct. This channel, which is to answer as a navigable canal, will be in one pond or level throughout, and be capable of carrying a maximum flood to the point at which the old Soar branches off, and two-thirds of the flood water below that point. It will have a bottom width of 60 feet for the latter section, with slopes of 2 to 1 pitched with granite pitching 12 inches deep to a height of 4 feet above the water-line on the one side, whilst on the other side there will be a concrete towing-path wall faced with brindle brick and provided with a Derbyshire stone coping, finished 2 feet above the ordinary water level. The towing-path will be 10 feet wide, and the slope on the west side thereof also 2 to 1. The slopes on both sides of the flood course will be carried up to a height 3 feet 6 inches above the anticipated flood level.

The old river Soar proper will be intersected by the new flood course about 170 yards to the north-west of the present stone weir,

and will be regulated and deepened with a bottom width of 30 feet and slopes of 2 to 1 from this intersecting point down to the Braunstone Gate Bridge, where an entirely new bridge 220 feet in length with a waterway of 45 feet in the clear, will have to be constructed. The extreme length and peculiar construction of this bridge arises from the necessity of improving the line and flow of the river at this point, which at present bends in an almost right angular direction through the Braunstone Gate Bridge, and also of providing for a new road to open up land belonging to the Corporation. A so-called grass weir, 150 yards above this bridge, will be demolished, and the surface-water level of the river lowered to the extent of 1 foot 10½ inches below this point, while above it for a distance of 900 yards it will be lowered 4 feet 10 inches, making one continuous pond or level of 1½ miles in length, from the Freeman's Meadow to the North Lock. Whether it will be necessary to pitch the slopes of this branch of the river as has been done in the works already completed, is a point on which there has been some difference of opinion, and will in all probability only be decided when the contract plans are laid before the Flood Works Sub-Committee.

As a part of this scheme, it is proposed to widen the West Bridge, to give increased water-way, effecting at the same time a much desired street improvement by the erection of a new bridge for a greater width of roadway at a lowered level, with an improved gradient. It is also intended to provide for other bridges along the new flood course for opening up the Corporation estate lying between the canal and river, and for which together with new roads the Estate Committee has made a provision of 15,000*l*. In connection with this provision a new road, extending from the Braunstone Gate across the river and new flood course into the Newarke, was projected and discussed by the Council, and plans deposited with Parliament, but eventually withdrawn.

In October 1881 a plan was prepared by the author, under the directions of the Estate Committee, and approved by the Council, for other new roads in connection with the flood scheme, but these are not included in the estimates for works now authorised further than that no doubt some of the requisite bridges will be carried out.

It will be observed that the new flood course forms nearly a straight line from the proposed new weir to the West Bridge, crossing both the old river and the canal, and that the works will have to be carried on in such a manner as not to interfere with or interrupt the traffic of the Leicestershire and Northamptonshire Union Canal.

At the junction of the old Soar with the flood course, the towing-path will be carried over the mouth of the former by a wrought-iron bridge of 90 feet span. The weir and lock to be constructed near the railway viaduct will be similar in construction to those already described, excepting that the section of the weir and lock walls will be proportionately greater and suited to the greater lift of 7 feet 6 inches which this lock will have. The length of the weir will be 500 feet clear of all obstructions, as there will in this case be no piers as for those previously described. A maximum flood of 400,000 cubic feet per minute will give a head of 2 feet 5 inches on the crest of this weir, thus reducing the former flood level from 2 to 3 feet on the high side of the weir, and beyond the railway to a considerable extent, even if no widening and deepening of the river and canal towards St. Mary's Mills be undertaken. It is proposed to raise the whole of the land belonging to the Corporation, and called the Bede House Meadows, 3 feet 6 inches above the anticipated flood level, and to form embankments on the east side of the new flood course and west side of the old Soar to the same level up to the new weir, on the high side of which the embankment will be correspondingly higher. The lowered summer water level of the whole of this section, and the reduced flood level which it is anticipated will ensue from the removal of the Castle Mill and Swans' Mill Locks, together with the increased sectional area given to both the new flood course and river, will have the effect of freeing from flooding the whole of the land hitherto subject to it, and afford increased facilities for drainage, the lowering of the water and flood lines being, in fact, equivalent to a raising of the entire district several feet above the river and canal, advantages which must result in an inestimable improvement of the sanitary conditions of the whole of the districts affected.

Increased borrowing powers to the extent of 60,000*l.* are being sought for the completion of this section of the work, making with what was sanctioned in 1881 for the works now in hand, 145,000*l.*, and with works executed under the Acts of 1868, 1874, and 1876, a total expenditure of 269,400*l.* for flood prevention works, roads, and bridges, exclusive of 40,000*l.* for the purchase of the Abbey Meadow and St. Margaret's Pasture, and 6000*l.* spent upon the Abbey Park Road, Slater Street extension, Pasture Lane Bridge, and the approaches thereto.

DISCUSSION.

Mr. C. Jones: I have been asked to speak, but really I do not know what to say with regard to the paper. It is simply beyond criticism, and I can only say in a few words that it seems to me that the paper which Mr. Gordon has produced, gives us a bright illustration of what can be done under the energetic management of such a Corporation as that at Leicester, with such an officer as Mr. Gordon. Those who were here ten years ago must have pleasant recollections of that visit. But the work that has been done here since is of such a character that I think we must congratulate Mr. Gordon not only upon the paper he has read—which is so lucid, clear, and explanatory in every detail—but that he has fallen upon such happy lines, and has the opportunity of carrying out such a splendid work, which to his last day he may be able to look back upon as a matter of gratification. It is not for many of us to fall into such a position. We may labour year after year, and have very little to show as the result of our labours. But not so in this case. A few years have given Mr. Gordon an opportunity of developing those powers which he possesses in a high degree, and which I trust are appreciated as much by those under whom he serves as they are by his *confrères*. It would be folly to raise any question of criticism. I am exceedingly gratified at the paper, and congratulate you upon this splendid meeting, which I should have been proud to have had during my presidency. It is the best I remember since the establishment of our Association.

Mr. MacBrair: I wish first to thank Mr. Gordon for his paper. But the question I have to ask is with regard to the ventilation of sewers. I see he gives in the paper three conditions for sewers, namely, properly constructed, well flushed, and proper regulations as to the temperature of the water to be admitted. I come from a town where all these conditions are carried out, and yet we have great complaints of the escape of sewer gas. I wish to ask Mr. Gordon to give us at Lincoln a wrinkle or two, as at the top of a hill, the gradients being on one part about 1 in 8, and in others 1 in 20, we find the escape of sewer gas very disagreeable. Notwithstanding that we have a proper discharge twice a day, and in spite of the great fall and the well-constructed sewers, we have still this sewer gas. I wish to ask if Mr. Gordon has come across experience of this kind.

Mr. Ellice-Clark: As sewage works have hitherto formed a large part of the duty of Corporations, so flood works are likely to absorb much of the expenditure of town councils in the next twenty-five years, and whilst other towns are flooded to an alarming extent, the Corporation of Leicester are to be congratulated upon having grasped this difficulty sooner perhaps than any other town, and upon having entered upon a large and I hope a successful scheme. There is only one point upon which I would ask for information, and that is why most of the weirs have fixed mounds instead of using floodgates where a large part of the waterway could be kept clear. I think that in all the weirs here except one, where there are four sets of floodgates, and a width of 26 feet of masonry and 56 feet of waterway, floodgates are not introduced; I should like to know what the difficulty is, whether there is no necessity because they can relieve the upper districts, with a slight head over the sill of the weir, without floodgates, or whether they have great difficulty in moving the floodgates in time of heavy floods. Because in India and on the Continent, movable weirs are largely used, and there has recently been carried out in the north of Ireland a scheme where about eight-tenths of the weir can be taken up without any difficulty in time of floods. With regard to the old and still vexed question raised by Mr. MacBrair, there should be no difficulty. I may say that I am surprised to hear of the Lincoln sewer system failing in any way. It was carried out by Mr. Mansergh, who is so excellent an engineer that one is surprised it has failed even in a matter of detail. But in regard to the particular question to which allusion is made, there are sewers laid under similar circumstances in all towns. In Hove there is a steep hill where the sewers are laid at a gradient of about 1 in 12 to 1 in 14, and there we had the same annoyance arising from the summit ventilators. The first thing we did was to put flaps in all the manholes. That did not succeed always, because the flaps got obstructed. Now all the manholes are furnished with water-traps, and I have adopted the arrangement initiated by our President at Oxford, where the sewer is carried at the same gradient from the upper level through the manhole, and is deeper underneath. I think if the Lincoln people were to have shackle flaps in the manholes, and then have a large siphon trap on the upper side of the manhole, they will find that the sewer air is localised and the complaints will cease. I see that Mr. Gordon alludes to a plan successfully carried out at Frankfort, that is, that in addition to the ordinary street man-

holes, wherever it is practicable, the manholes being left open as in most of the towns of this country, rain-water and other pipes in connection with the sewers are carried up the sides of the houses. In West Brighton we are now dividing the town into a particular section where we are going to carry that out. The particular sewers fall about 1 in 20, and ventilators average about 60 feet apart. There are no lampholes, the whole of the ventilators being 5 feet in diameter at the bottom, and 1 foot 10 inches at the top, and one would think that in such a case 60 feet apart was ample ventilation. But great complaint has arisen from the inhabitants, and we have asked every householder to give permission for us to connect the rain-water pipes from the houses in addition to the street ventilators.

Mr. Thoms: There is little in the paper to take exception to or to criticise, but it occurred to me on hearing the paper read, as being rather peculiar that a certain portion of the cost of the storm sewers should be charged to the revenue account, and a certain portion to the rates. I do not understand that, and should like an explanation of it. As I understand it, all main sewerage work should be charged to Capital account. With regard to the ventilation question, with which we are intimately connected, it appears to me that the lampholes, of which there are two hundred and forty-five referred to in the paper, are not so practical or efficient as manholes, and as a matter of fact they are never used. I understand that the idea is to put a lamp down in order that the sewer-men may see if there is any obstruction. Has that ever been done? I never heard of it, and I know there are many in my own town, but I never heard of an instance in which it was done. I always remove the lampholes and put down a manhole in which a man can go down, and which can be also used for the purpose of flushing. Another point was, how far apart are the manholes? I think they should not be farther apart than 50 yards. I do not know how far they are now, but if there are any complaints with regard to a manhole, I should have another as near as possible to it. The great thing is to get the sewage away without the generation of sewage gas. You want the sewers properly designed in order to get the sewage matter to the outfalls with the least possible delay. I think Leicester is to be congratulated upon having such a man as Mr. Gordon at the head of affairs. I have had two years of work similar to this myself, and I am quite satisfied from the experience I had and the opportunities of seeing

over 150 miles of navigation work, that there is no town in the kingdom where work is done more substantially. It will not want enlarging, for what is being done here seems to be for all time, and I think Leicester is to be congratulated upon the excellent judgment shown not only in the selection of the engineer, but in the carrying out of the work. An engineer may be ever so efficient, but he has to satisfy his committees, and often, after having designed an excellent work, he is unable to carry it out. That cannot be avoided always, though the difficulty does not seem to be so in this case.

Councillor Underwood (Leicester): Having been chairman for two years of the Flood Works Committee, and having been associated with it from an early period, I may be allowed to answer one or two of the questions which have been put. With regard to movable weirs and floodgates, we have a navigable canal to deal with, and gentlemen will see at once the difficulty which would be experienced by the swamping of boats in close connection with the wharves and business of the town. We have had difficulty in the past, and claims have been made on account of boats being upset in front of the gates. It was also thought by the committee that anything that was automatic in its character would be the most natural, simple, and effective, and could be more depended upon than anything you have to keep a man to attend to. Suppose, for instance, weirs had to be opened or floodgates closed, and there was a sudden necessity for the man to be called at night, the district might be flooded before you knew where you were. That has been our experience in the past, and therefore we now wish to have elongated weirs. With regard to the ventilation of the sewers, that is a matter on which I cannot say we are exactly at one. There have been doubts in my mind as to the propriety of using street ventilators wholesale, and lately we have adopted the use of chimney-shafts. We find that the engineer has practically to apologise for ventilating in the streets, by suggesting the insertion of a zinc plate under the ventilating grate where it is denounced as a nuisance, but this is of course only done in cases where people loudly complain and appeal to the committee or surveyor for a remedy. I believe that in some of our streets very great hardship is felt, and has to be endured on account of these ventilators, and in a town like Leicester, where we have no clear outfall, and where in some instances the sewers are practically elongated cesspools when the lower districts and the river are flooded, I question the absolute propriety of them. I

do not see how the generation of sewer gas can be effectively dealt with by these street ventilators, assuming that it does generate with rapidity, and to a large extent in the high districts, without its becoming not only a nuisance, but to a certain extent injurious to the health of the people in narrow streets where the sewers are only a few yards from the doorway. If the gas is noxious it must deteriorate the air, and thus children especially are prejudiced in health by these street ventilators. I think that ventilation should be by means of *shafts* carried to the factory chimneys and otherwise, a great draught occurs there and effectually carries away the gas. We are getting as many of these as we can, but I do feel a little suspicious as to the ultimate effect of a vast number of surface ventilators in the open streets. I think we should have more shafts, and thus take the sewer gas above the breathing population.

Mr. Newton: I would bear my testimony to the manner in which I believe the work in Leicester is being carried out. It is rarely we have an opportunity of seeing work of this sort actually in the course of execution, and I think the manner in which this is being done is the best and most substantial possible. But I wish to ask with reference to the provision for the maximum floods, which is set down at 400,000 cubic feet per minute—is that from accurate measurement based upon the greatest flood upon record? I do not know the drainage area of the Soar valley, but taking it roughly, I make it about 90,000 acres. If that is right, the provision for 400,000 cubic feet per minute is equal to about 74 cubic feet per thousand acres per second, and that is a small average. Some years ago I had occasion to gauge several rivers in Lancashire, but I do not expect to find the same quantity of water here as there, because we have a higher rainfall there than here, and the water runs off the ground more rapidly there than it does here. But in one case, in the valley of the Irwell, at Manchester, in 1866, in 166,000 acres of drainage area I found that 185 cubic feet per second per thousand acres flowed off. Mr. Bateman also gauged some of the district of the river Medlock, and in 1857 he found that 255 cubic feet per second per thousand acres ran off the ground, being an area of 12,000 acres. He also mentioned the Glasgow Waterworks. The highest average he had recorded up to 1854 was 122 cubic feet per second per thousand acres, whereas here at Leicester provision is only made for 74 cubic feet per second per thousand acres. I should like to know whether that is from actual measurement.

Mr. McKie: The explanations which have been given during the day by Mr. Gordon have given me answers to the questions I wished to ask, and during this visit to-day I have seen nothing but work which will, I believe, under the careful guidance of the borough surveyor who is carrying it out, thoroughly serve the purpose for which it is intended. I simply rose to say that so far as I have been able to see to-day, the flood works appear to me to have been liberally designed and well carried out.

Mr. Lobley: I can corroborate Mr. Gordon with regard to the ventilation of sewers. Probably my town is not so steep as Lincoln, but we have a vertical difference of level of 300 feet, and some steep gradients, and I have had no complaints of the open manholes ever since they were constructed. I have abandoned the lampholes in new works, and substituted manholes. Up to the present I prefer the open manholes, because if a stink occurs I like to know it as soon as possible. If it occurs in a shaft, it may go on for a long time without being found out. I contend that there should be no bad smells from these manholes. The District Secretary and other Members who were present at a meeting at Hanley went down our principal sewer and will bear out my assertion that the ventilation was good. I contend also that sewer gas is not generated with great rapidity in properly moving sewage. The sewage in most parts of my town can get to the end in twenty minutes. It moves at least 3 feet per second, and there should be no bad smell in that. At flood times there should be no bad smells generated, and no great pressure of sewer gas. The appliances alluded to by Mr. Ellice-Clark are used, and we have no complaints in the upper parts of the town. I should like to express my hearty thanks to the Corporation of Leicester for the handsome way in which they have received us to-day.

Mr. Pritchard: I confess I am very much of the mind of the gentlemen who have spoken, that there is but little to ask Mr. Gordon. I have one thing to put to him, and that is that he will give me another opportunity of making a further inspection of the very important works which I have but casually seen to-day. He is placed in the fortunate position of being engaged in a vast undertaking, which appears to show the greatest ability on his part. He has also prepared a paper which I have read carefully, and I have no question on it to ask. My feeling is simply one of congratulation to Mr. Gordon for having prepared so great a treat. If there was anything that I would like to have suggested it would

have been that we should have had such a reception at an annual meeting, instead of at a district meeting, when we could have more fully acknowledged to Mr. Gordon in a more proper and becoming way our approval of what he has done. No doubt that day will shortly come. I find in Mr. Gordon's paper he says, "the author is of opinion that in a properly constructed system of sewers, kept in good order by flushing arrangements and proper regulations as to the temperature of the water to be admitted," &c., he is in favour of surface gratings, and that the more numerous they are the better. During many years I have had considerable experience of sewage, and if I had been requested to give an opinion on this subject, I should have given it word for word as Mr. Gordon has there. The question of sewer ventilation is indeed a vexed one. It has been dealt with ably in papers read by Mr. Ellice-Clark, Mr. Lewis Angell, our first president, who is justly termed the father of this Association, and other gentlemen, and it has, I think, been proved to the satisfaction of every engineer, that if sewers are placed under such conditions as Mr. Gordon lays down that opinion cannot be challenged. It is the sewers that allow decomposing matter to lie about that require this great attention. During this discussion reference has been made to ventilation down spouts, and by means of chimney-stacks. The spout arrangement is an obsolete one. At the time when the spout is required as a ventilator it is filled with water, and though other pipes constructed specially from the sewers have been tried, it was not with very great success. Liverpool has not been successful in its system of ventilation by putting up these pipes. Again, we have had experiments tried in London, and the reports of eminent sanitary engineers are not in favour of ventilation by chimney-stacks, as they prove that it is of little effect beyond the immediate locality in which it is placed. I come back to the point of open ventilation, and believe that with properly constructed sewers and a proper temperature of the sewage discharged, which is a very important element, it is unnecessary to do more. But it is very necessary that every house-drain shall have an outlet if possible above the roof, or above the eaves of the house. I should like to refer to one large town in the country, where I have had some experience of sewer ventilation, and that is Birmingham. There the principle of ventilation is that adopted by the author of this paper in Leicester, and recommended by him, namely open ventilators. The superficial configuration of the

town is remarkable, and like the town referred to by Mr. Lobley has some considerable falls. But there appears to be very little reason to find fault with the system of sewers there. The town has some remarkably objectionable sewage, and no doubt in some places there are outcries. I have heard of great stinks in Edgbaston. But when the matter is investigated, it is found to be simply the decomposing sewage in the house drains. There are trap-closets, and thus the smells get into the houses. But that is scarcely a proper complaint against open ventilators. I would strongly impress upon the meeting that as far as my experience goes—and it appears to be the same as that of many other engineers upon the subject—I agree with the expression of opinion given by the author of the paper. I have made an inspection of the sewers in Hanley, where they have open ventilation, and really there is not the slightest foul smell whatever there; I have been informed by the engineer of that town he has no system of down-pipe arrangement. No doubt his house drainage connections are fully ventilated, but it is clearly proved to my mind that it is defective sewers with rough surfaces, which allows of it becoming dry, and thus decomposition sets in, which requires the closing of ventilators. To my mind it is dangerous to do that, because by doing so you create greater pressure at some weaker point, and probably that may be near a dwelling-house. I must again express my feelings with reference to the reception we have received on the part of the borough surveyor, to whom we are deeply indebted; I can only reiterate what has been already said, that he is a gentleman whom we believe to be in the first ranks of his profession, and fully competent to deal with these great and important works, and one whom no doubt the Corporation will feel perfectly safe in having entrusted the work to. But I may also take this opportunity of thanking the authorities of Leicester. Over ten years ago we had an important meeting here, and on that occasion received very great kindness indeed. That has been very considerably added to in the meetings to-day, and I think we may take it that that is partially brought about not only by the liberality of the gentlemen representing the Corporation, by their consideration for science and scientific men, but also partly no doubt by the great respect they, like ourselves, have for their borough surveyor.

The PRESIDENT: There are a few questions regarding the paper which I had myself intended to ask, but being placed in the position of President most of them have been asked for me. I would simply

ask Mr. Gordon in replying upon the question of sewer ventilation to state whether it has ever occurred to him that the complaints of smells from manholes occur more or less frequently at the junction of two or more sewers, or whether they are almost exclusively at summits. My own experience rather leads me to believe that there are more escapes of sewer gas at points where the sewers meet. I can hardly think that in any system of sewers which may be laid down in an old town, smells can be entirely avoided, but I am very much of the opinion expressed by Mr. Pritchard, that they may be traced almost wholly to foul untrapped house-drains. There is one other small point. With regard to asphalte, Mr. Gordon referred to an asphalte he has tried for footways. If it can be done without infringing any patent, will he give us information of its character and cost, and with regard to the tar paving at 1*s.* 4*d.* a square yard, what is the thickness and composition of that? I am very pleased to be able to agree with the many expressions of opinion which have been given as to the excellence of the work which Mr. Gordon has designed and is carrying out, and which the Mayor and Corporation of Leicester by their liberality are enabling him to do.

Mr. Gordon, in reply, said: Mr. President and Gentlemen, I am exceedingly gratified at the reception which this paper has met with at your hands. I was quite prepared to hear very considerable criticism of some of the expressions of opinion that occur in it, and I am not in the slightest degree disappointed that at any rate on one point there has been some criticism. I mean with regard to the ventilation of sewers. Mr. MacBrair was the first speaker, and he went straight to this point. He said that in Lincoln, where, I think most of us know an entirely new system of sewers has been carried out by one of the most eminent engineers of the present day, they have already some difficulty at the summits of that system. Well, I may say with reference to that, as our friend Mr. Clark said, that I am a little surprised to hear it, because it cannot be said in this instance, I take it, that it is from any fault in the construction of the sewers themselves. I think I understood Mr. MacBrair to say also that some of the suggestions thrown out by Mr. Ellice-Clark had already been adopted, but I did not quite understand whether they had been successful or not.

Mr. MacBrair: Unsuccessful.

Mr. Gordon: Well, I can only say that it is contrary to my experience to hear that that is so, and I should certainly think

there is something which we have not been told in the local conditions of this particular place which would sufficiently explain it to those who have had much experience in the matter of ventilation. I have no doubt whatever in my own mind, that that must be so, because I know cities which are ventilated in this way where the gradients are quite as steep as those referred to by Mr. MacBrair—and I have cartoons here showing German cities where the gradients are equally steep, and where it has been successfully done and no complaints have been made. We are not told whether in Lincoln there is that system of flushing the sewers which I hold that in all newly constructed sewers there ought to be; but I know, from the gentleman who acted as consulting engineer at Lincoln, that it is within his experience that provision has been made for flushing and ventilation of sewers in certain towns, which in the course of time has been allowed to lapse into desuetude. It has in fact been totally neglected. That, however, cannot be so in Lincoln, because there the sewers are too new. Have the falls in this case, however, been broken up in the manholes, as Members know has been done in some places. If light flaps are adopted at the manholes, and changes of gradient, you will localise the sewer gas which is generated, and will not be subjected to the penetration of that gas from the lower to the upper districts. Probably something which ought to have been done in the case of Lincoln has not been done. I will tell you what has been done in the case of Frankfort. There we have also very steep gradients, I think at the steepest place 1 in 20. At any rate some of the main thoroughfares are very steep. We have at the summit and extreme points of each of the districts there, in addition to the surface ventilators, erected large shafts of about 5 feet internal diameter and 100 feet high which take away the great pressure at the very highest points. But, as has been observed by Mr. Pritchard, you must not rely too much upon large shafts. I have expressed my opinion to the Highway Committee of this town, that it is a mistake to suppose that if you have the whole of the factory chimneys connected you will have solved the difficulty. You will do no such thing. The connection with a factory chimney only affects and operates upon a limited length of sewer and area of the immediate locality, if you break up the falls and flatten the steep gradients and rely more upon the ventilators and a systematic course of flushing, and if your house-drains are carried out with the same degree of accuracy and carefulness as should

be brought to bear upon the public sewers, then there ought not to be the difficulty which we hear of as existing at Lincoln. There is no such difficulty in the towns represented by the cartoons you see on the walls. In the case of Frankfort, there are no fewer than 25,000 water-closets. There are few towns of a population of 140,000 inhabitants where you find such a complete and thorough system of water-closets as you do there, and if there was anything wrong in the system of open ventilators we should certainly have heard of it in that city as quickly as in any town I know. But there have been no complaints whatever, and we have gone a little further there than is general in ventilating sewers. We have utilised the private drains also and the rain-water pipes. But again I would say do not rely upon rain-water pipes too much, because at the moment the greater pressure occurs they are filled up with rain-water, and practically of no service. Mr. Clark asked a question with reference to floodgates, and why we do not use them more in our weirs. That has been answered, I think, by the Chairman of our Highway Committee, and the only thing I can say is, it is quite correct that at the weir called Evans', where the navigation bends, it would be exceedingly dangerous to have more floodgates. On the Continent the needle weirs are made more use of than in this country perhaps, two-thirds and even more of such a weir being capable of being removed. They have been constructed where they can sweep away the entire weir in time of floods. But these are not automatic, and it is in this fact that we have probably the best answer, that it is necessary that everything that is done with the view of preventing floods should be done as far as possible in an automatic manner, that is, in such a way as not to rely or depend upon manual labour. Mr. Thoms, I think, said first of all there was a point with regard to the storm-water sewers, that he should like to hear more about. It is an exceedingly simple one, as to how it came about that part of the expenditure on the storm-water sewers was paid out of the current year's rates. It occurred in this way. The Corporation obtained power from the Local Government Board in 1878 to borrow 12,000*l.* upon the plan then sanctioned showing certain main-trunk storm-water sewers, and money spent upon these lines of sewer is of course taken out of the loan, but for the supplementary sewers which I have advised as having been necessary, it has been thought wiser to meet the expense out of the local rates rather than to ask for power to borrow again from the Local

Government Board. But before the storm-water system is extended throughout the whole of the town, it has become a question whether further borrowing powers should not be obtained. Mr. Thoms also referred to lampholes and manholes. I think that probably he and other gentlemen who referred to these, misconceived the term "lamphole," as used in this paper. If I were constructing a new system of sewers, where they were not large enough for a man to go through, I should construct them in straight lines, after the well-known manner recommended and carried out by Mr. McKie and adopted by Sir Robt. Rawlinson and others thirty years ago, and would adopt lampholes and manholes in connection therewith. But in Leicester, in applying them to the old sewers, they are called lampholes simply because they have the form of what were originally understood to be lampholes. They are put down at about every 40 yards. We have had occasion to examine and cleanse our existing main sewers. In doing this we were obliged to sink down shafts, and when they were open I took occasion to bring up these lampholes where it is not necessary in my opinion to have manholes. But they are after all in our case simply ventilating shafts. I have plans here to show that these ventilators are of sufficient size for ventilation by 9-inch pipes. The manholes here are about 100 yards apart, and if I were designing a new sewerage system, I should think that 100 yards ought to be sufficient. Lampholes give you the means of inspecting the flow of the sewage and ascertaining if anything is wrong or not. Mr. Underwood, the Chairman of the Highway Committee, has forestalled me to some extent with regard to the question of ventilation, but he knows, as he said, that I do not agree with the view he takes upon this matter. I agree simply so far, that in ventilating a system of sewers which was originally, or has become in the course of time from causes which I could describe, inefficient, defective, and liable to allow the sewage to stagnate and to give off sewer gas, such as should not be given off in well-constructed sewers, in that case I say that open ventilators are liable in some instances to become a nuisance. I cannot dispute that now, and I have admitted it. But in Leicester you must remember we are dealing with an old system of sewers, constructed thirty years ago, and no doubt efficient for the population at that time. But the population having increased, and no effective measures having been taken to increase the capacity of the sewers so as to be suitable to the size and ramifications of the town

at the present time, it is quite clear that these sewers have been put under a pressure which to some extent has almost ruined some of them, and we cannot blind ourselves to the fact that many of them are in an unsatisfactory condition. Nearly all the cases where complaints have been made, I find on investigation that it is and has been at those points where we know the sewers are in an unsatisfactory state. It must not therefore be contended as against the system of ventilation by open gratings that this is wrong in principle because it is not quite so successful as desired in particular instances, where the sewers themselves are inefficient, and the question still remains whether it is not better in the interest of the health of the people, that some little inconvenience which may here and there arise from the open ventilators should be tolerated rather than that the sewer gas should be allowed insidiously to find its way into the interior of our dwellings in the still hours of the night, when the houses are all locked up and we are unconsciously inhaling the deadly poison and sowing the seeds of disease. Mr. Newton has asked a very pertinent question, and I am very glad to find that we have a gentleman of his experience here to-day coming straight to a point like this, he has asked whether we are making sufficient provision for the carrying off of floods in the town of Leicester. He has given you instances, and told you that in a case where the drainage area was 166,000 acres he found that the maximum flood amounted to 186 cubic feet per second per thousand acres. He has given us other instances also of 253 cubic feet, and 122 cubic feet per second per thousand acres, and he is surprised —and I do not think it is astonishing that he is surprised—that we are not making greater provision in Leicester. Our provision is very much below any of the figures he has given, and I may tell him that the drainage area from which we have to take the water through Leicester is, as he very justly put it, about 90,000 acres (94,000). But it is on the authority of Mr. Hawksley, who was called upon as I have stated in my paper to report upon the subject and upon the scheme which was sanctioned by Parliament in 1881, that provision for 400,000 cubic feet ought to be made. He does not tell us in his report how he arrived at this conclusion, but we had a flood in 1882 which gave me an opportunity of gauging to a certain extent the water passing through Leicester. I was somewhat taken by surprise as it came very suddenly, or I should have had a better opportunity of gauging it. But I tried to form some estimate of the quantity passing through the town at a maximum

flood which was of short duration, and I came to the conclusion, and in a report which I made to the Highway Committee I certainly just indicated, as I did not wish to alarm the authorities in any way, that I thought as we have an important drainage area above Leicester which by improved land drainage would bring down the water more quickly, it was not at all improbable that the provision for 400,000 cubic feet was not overstated, but if anything under the mark. The quantity of water passing through during the flood in 1882 was, according to my estimate, rather over 400,000 cubic feet, and therefore, if we get a flood higher than that, we should as a matter of course have a greater head of water passing over the weirs. But I think that flood was as high as any there has been, and I do not think there is a probability of reaching the figures quoted by Mr. Newton. Mr. Lobley has also mentioned the question of steep gradients in sewers, and I am glad to hear he has the open system for ventilation of sewers without complaints arising. Mr. White asked the question, whether the complaints arose at the summit or at the junction of the sewers. In answer to that question I may say that they arise at both, within my experience in Leicester. But the worst cases that I have had occasion to observe are at those points where the sewers of side-streets drop into a manhole, or a main-trunk sewer, several feet above the main sewer. It has been the custom in carrying out many of the sewers of Leicester, where the main trunks were very deep, to run side sewers into the main-trunk sewers 7 or 8 feet above the invert. You will readily understand that the agitation resulting from the two side sewers coming in in that way interrupts the ventilation through the main, and sends it more violently upwards, and that is where the complaints have mostly arisen. I believe I have now answered all the questions I have had put to me.

Mr. Jones: I wish to thank Mr. Gordon for the great trouble he has taken with his paper, and also for the trouble he has taken to-day. It is very gratifying to see such a large meeting, one of the largest I have ever seen at a district. I propose a vote of thanks to Mr. Gordon for the great trouble and interest he has taken in this matter. With regard to the Corporation of Leicester, their hospitality is not yet over, and gratitude now is a lively expectation of favours to come. We shall be able to acknowledge that later on.

Mr. Parry seconded the vote of thanks, which was supported and put by the Chairman, and unanimously carried.

Mr. Gordon, in reply, said: I shall not detain you by having anything further to say besides this, that it has given me the utmost possible pleasure to be able to show the Association, and those Members who have come from long distances as well as from nearer home, anything that is in my power. I am delighted to find that we have not only had an exceedingly pleasant day—that the weather has favoured us—but that you have found so much of interest in everything that has been shown to you. The members of the Corporation themselves will, I hope, also feel that this meeting has been exceedingly gratifying to all who have taken part in it.

In the morning the Members visited the Flood Works District, first going to Swan's Mill, where a plan showing the work in progress, and that intended to be carried out by the Corporation was fully described by the Borough Surveyor. A move was then made along the towing path to the West Bridge, and thence to the Bow Bridge, where the improvements in progress were explained, as also was the immense work which was being done under the railway and up to the Soar-lane Bridge. Mr. Gordon explained that in order to prevent the overflow of the canal at Bow Bridge, it was found necessary to add an arch to the bridge and widen the stream, and also to carry the course straight under the railway to obviate the turn almost at right angles under the line which had, in times past, been the cause of the water backing up considerably. The Soar-lane Bridge and the preparations for the weir to be made there, with the other alterations now being carried out, were next examined. A visit was then paid to the new baths in St. Margaret's Pasture, thence to the Abbey Park, where light refreshments were provided.

Subsequent to the discussion following Mr. Gordon's paper the Members of the Association were entertained at a Banquet in the Masonic Hall by the Corporation, under the presidency of the Mayor, and at which about 100 *sat down. After dinner a short toast list was gone through, during which pleasure was expressed that the Association had honoured the town with a visit, and best wishes for its future prosperity were accorded.*

DISTRICT MEETING AT EALING,

HELD IN THE LYRIC HALL, EALING,

May 24, 1884.

Mr. W. H. White, *President, in the Chair.*

Mr. O. C. Robson, Hon. Sec. of the Home Counties District, read the minutes of the last meeting, which were confirmed.

The Chairman said the next business was to hear a paper on

TWENTY YEARS' DEVELOPMENT OF A LONDON SUBURB,

By CHAS. JONES, Assoc. Inst. C.E., Engineer and Surveyor to the Local Board, Ealing.

It is with very great pleasure I welcome you, the Members of the Home District of our Association, together with Members of other districts, to the village of Ealing. It was my wish that this visit should have been paid during the past year, when you honoured me by electing me your President. Circumstances, however, over which we had no control, and the bankruptcy of the contractor who was then engaged in carrying out the extension of the Ealing Southern Works, prevented the meeting taking place till after the expiration of my year of office, and I cannot sufficiently express my gratification at seeing so large a number present, especially when I recognise the fact that some of you have travelled very considerable distances to pay us this visit. Whenever the question has been mooted with respect to the meeting at Ealing, I have always felt a degree of diffidence in the carrying out of the proposal, not because I feared you would not receive a hearty welcome from those with whom I am associated in the Ealing district, but because I feared that in a visit to a suburban village, to those of you who are accustomed to the larger towns of the midland and northern counties, little could be shown to interest you, and the greatest difficulty in connection with the present visit

appeared in the arrangement of papers for discussion, and works to be inspected, which would repay you for the trouble you have taken. Still, we have done our best, and I hope that at the close of to-day's meeting you will feel that it has not been a day lost, but that information has been obtained which may be useful to you in the multitudinous duties which fall to the lot of a municipal officer or engineer and surveyor to a local board. We cannot at Ealing point, as our worthy President can, to the many interesting features which gather around a town like Oxford; we cannot, like our friend Pritchard, call attention, as he did, in times gone by, to the historic reminiscences which are associated with Warwick; nor can we, like our friend Gordon (whom you last visited at Leicester), look back for hundreds of years upon the stirring memories of the town, and tell you that in this spot a King Richard lies buried, or in that ivy-covered ruin a Wolsey died; neither can we point to the immense works such as he is carrying out, and to the tens of thousands of pounds which are being so well and wisely expended. All we can do is to call your attention to a suburban district, twenty-five years since a country village (just outside the bounds of the great metropolis), which during this short period has developed into a suburb which gives place to none, either in its gradual and yet well-founded growth, the healthiness of its atmosphere, or the influence which it has brought to bear in connection with drainage and sanitary work upon the country at large.

The district of Ealing is situated some six miles from the Marble Arch. For many years it had been the favoured residence of men whose names are household words in the records of England's history. It was formerly called Yealing, or Zealing, of the Hundred of Ousselton, in the County of Middlesex. Amongst men of note we may mention the Earl of Rochford, the Dukes of Marlborough and Argyll, Sir Francis Dashwood, the Percivals, Lord Brooke and Lord Robert Manners. John Horne Tooke, and the great political writer of the last century, John Oldmixon, were buried here; Sir William Lawrence, the eminent surgeon, died here, and was buried in the old parish churchyard. The great Lord Heathfield dwelt in our village, and at Fordhook (now the residence of one of our respected members, Captain Tyrrell) resided Henry Fielding, the novelist, and subsequently Lady Byron. In the drawing-room, "Ada, sole daughter of my home and heart," was married to Lord King, afterwards Earl of Lovelace. The Duke of Kent lived at Castle Bar Park, and the late Home Secretary, the Right Hon. Spencer Horatio Walpole, has been for many years and is still a resident

amongst us. The village has always been noted for its high-class schools; the largest private establishment in England, Great Ealing School, was kept for many years by the Drs. Nicholas. Probably not many private tutors could show a longer list of scholars who became men of note than could the Nicholas family—amongst others, Sir Henry Lawrence and his brother Lord Lawrence, Bishop Selwyn, Charles Knight, Sir Henry Rawlinson, Cardinal Newman, Captain Marryatt, Lord Truro, and many others.

The district of Ealing consists of about 3225 acres, the main road from Uxbridge to London passes through it, and is slightly over two miles in length. The 200 feet O.D. contour line runs through the district from east to west, and the ground falls from 200 feet at the contour line to about 37·0 O.D. at the southern, and 50·0 O.D. at the northern outfall, giving a fall of about 150 feet to each set of sewage works; a fact which has considerable bearing upon its healthiness and the possibility of making a first-class drainage district. The geological features bearing upon the sanitary condition of the district, will be fully touched upon by our friend, Mr. Allen Brown, and it would be strange indeed if, being physically so favoured, and its artificial drainage so thoroughly carried out, it should have fallen short of the high character which we believe it has acquired.

The district of Ealing over which the Local Board have supervision is not co-extensive with the parish of Ealing, which includes Brentford, the county town of Middlesex, a county which contains within its boundary the City of London, the City of Westminster and its palaces, and the fountain head of the government of a large portion of the world. Some twenty-five years since it became apparent to some few thoughtful men then residing in the village that the time had come when steps should be taken towards developing its qualities as a residential place, and an endeavour was made to induce the town of Brentford to co-operate in the formation of a governing body who should exercise the jurisdiction of the Public Health Act of 1847, and under the powers of that Act bring about a change for the better. At the time to which I refer, Ealing had a population of about 5000. It was governed by what was known as a Highway Board, the members being elected for life, and the officer to carry out the duties of surveyor originally followed the occupation of a gardener. We do not disparage the position of such a Board or those who carried out its directions, but the time had come when further development was necessary, and the machinery was not equal to the work. The town of

Brentford, not being disposed to fall in with the above proposal, and having succeeded in defeating, by vote, the formation of a local board for the entire parish, a district was formed under the powers of the Act within the parish of Ealing, and on May 25, in the year 1863, the first meeting of the Ealing Local Board was held. It will, therefore, be perceived that the Board has just attained its majority. One of their first acts was to instruct their Surveyor, the author of this paper, to prepare a scheme for the drainage of the southern portion of the district, and, after much consideration and investigation as to the best mode to be adopted for dealing with the sewage question, a scheme was prepared and submitted to the Board for the drainage of that part of the district which lies south of the Great Western Railway. Land was procured in the southern extremity of the district for the erection of precipitating works, and at an early date contracts were issued for the construction of the necessary lines of sewers and works connected with the same.

It would be impossible, in the short space allotted to such a paper as this, to go into the details of these several works. Suffice it to say that the sewers throughout the district vary in size from 12 in. glazed stoneware pipes to 3 ft. 9 in. by 2 ft. 6 in. egg-shaped brick sewer, with gradients varying from 1 in 60 to 1 in 946. The entire length of the first contract being somewhat over eight miles, the length of sewer now in use in the district is about 27 miles, exclusive of surface drains. The rateable value of the district at the time to which I refer was 18,369*l*., and when it became known that a sum of 21,500*l*. was to be expended in the construction of tanks and sewers, and the purchase of the land, not a few of those who may be called the old residents of the place looked forward with a feeling of dread, and prophesied that the Board and their officer would ruin the village. The twenty years that have passed since that time can best give the answer to the doubts then raised. The constitution of the first Board I consider the principal factor in the prosperity of the place. Nine gentlemen were elected, principally men of property, and with liberal views, who, appreciating the possibility of a large increase in population, and the necessity of making provision for the future, having no individual peculiarities to carry out, but actuated by one simple object—the prosperity of the district, and having full confidence in the officers they had appointed, and the schemes propounded, they gave that moral support which was so necessary

under the circumstances, and which resulted in the successful development of the district, beyond their most sanguine anticipations. I may add that the doubts expressed with respect to the necessity of such extensive works not only found expression among some of the inhabitants of the village, but even a highly respected and well qualified officer of the Local Government Board went so far as to express a doubt as to the necessity of providing for such an increase. What better reply can be given than the following figures? The rateable value in 1863 was 18,396*l.*, and now, in 1884, it has reached 118,071*l.*, or an increase since the first rate was made in 1863 of nearly 100,000*l.* The rateable increase per head of the population from 1871 will be seen from the following table:—In 1871, 4*l.* 15*s.* 6*d.*; 1881, 6*l.* 7*s.* 10*d.*; 1884, 6*l.* 16*s.* 8*d.* This table shows that the class of property has in no way deteriorated, the rateable value per head having increased in excess of the rate of increase of population.

Shortly after the formation of the Board, the Metropolitan Railway was opened, and this, I am free to confess, exercised a considerable influence on my mind in the advice I gave as to the necessity for preparing fully and substantially for further development. The tendencies of all large cities throughout the world are towards their western suburbs, and it was felt that a district so splendidly situated must, ere long, become a point to which many of the City and West End men would turn their attention. Nor were we disappointed in this, for in the year 1871, when the census was taken, the population had increased to 9959, and the rateable value had risen to very nearly 48,000*l.* So rapid had the increase become that in the year 1868 we found it necessary to increase the size of our subsiding tanks at the Sewage Works and to simple "subsidence" was added the "lime process," with the addition of a large filter screen. Much public attention was directed to the Ealing Works by those who were interested in the subject, and I believe I am right in saying that Ealing was the first place in the valley of the Thames where a thorough and efficient mode of treatment and purification of sewage was tried; and it is worthy of remark in connection with this matter that Ealing, by its energy in dealing with this subject, has had its reward, for while the towns along the banks of the Thames have been engaged year after year in litigation, vexatious inquiries, and the expenditure of thousands of pounds of ratepayers' money, in fruitless endeavours to carry some grand and imposing

scheme into effect, Ealing has gone on its way without litigation, and up to the present moment prosperously, in all sanitary matters. It must not be supposed, however, that the district has been without its troubles. Its very prosperity led to attempts being made to draw it, if possible, within the meshes of the propounded schemes.

The eminent engineer of the Metropolitan Board of Works cast longing eyes upon Ealing, when he proposed his Bagshot scheme in 1871. A report issued by the Ealing Local Board upon this scheme was taken up by an important committee in London, and some thousands of copies were distributed. The Bill for this scheme was eventually withdrawn. Later on another attempt was made to incorporate Ealing in the Thames Valley Drainage Scheme. We were fortunately, however, able to prove our case, and show that we had for years been doing our work, and doing it well; the result was that Ealing was omitted from this scheme. The cost connected with that futile matter amounted to between 40,000*l.* and 50,000*l.* Ealing escaped her share, which would probably have been some 7000*l.* In the early part of 1868 some of the Thames Conservators visited our works, together with their chemist Dr. Letheby, and expressed in writing their great satisfaction with the character of the effluent, and in the year 1878, Professor Way, the eminent chemist and Royal Commissioner of Rivers, visited the works on many occasions during the summer season, and made an elaborate report upon them, and pronounced them amongst the best, if not the best of any works in the country. The principal cause of the Professor's visit was an attempt made by a foreign adventurer in sewage matters to obtain possession of the works under the pretence of carrying out experiments for the manufacture of valuable manure. Upon this I need make no further remark. The experience of not a few of those present agrees with my own upon the question of *valuable manure.*

Up to the year 1869 the Highway Board referred to had still the control of the roads and paths, but the remaining portion of the parish having decided to move in the same direction as we had already done, and to form a Local Board, joint action was taken for doing away with the Highway Board, and so throwing the whole charge of the roads, &c., upon the Local Boards. When we started in 1863, as I have before intimated, Ealing was simply a village, without a public gas lamp, without a sewer worthy of the name, and without a properly formed road, with the exception of the main road. No sooner, however, was the

Highway Act repealed than the Local Board determined (again in opposition to those who would have patched here and there, done a little piece to-day, and a little piece to-morrow) to make one bold and decisive move for the re-construction of their roads, and a sum close upon 10,000*l.* was expended within the next twelve months, altering in the most thorough and efficient manner our roads and paths. Messrs. Mowlem and Co. carried out the contract for paving, kerbing, and channelling, and Messrs. Wright and Co. the contract for tar paving, in which latter item alone nearly 2000*l.* was spent. The expenditure seemed large, but I am sure that those who remember the immense improvement which took place within the period of twelve months will feel that it was wise and judicious, and illustrating again that a bold and liberal policy is the wisest in the end.

In 1873 the Board was memorialised to take in a certain portion of the northern district not included in the previous order. Application was made, provisional order was granted, and three new members were elected to represent the incoming district, raising the number of members on the Board to twelve. The boundary of the district was thus extended to the parish boundary on the north, namely, the river Brent. This increase of district at once necessitated a further drainage scheme, nearly the whole of the new district falling to the north. A plot of land some twenty-two acres in extent was purchased, and the drainage scheme was laid out by the author to accommodate the then existing properties, and making necessary arrangements for an estimated increased population of 15,000. About 10,000*l.* was expended in land, works, and sewers.

I cannot lay claim to our having a sewage farm in the ordinary acceptation of the term, but inasmuch as the neighbourhood on the north grows but slowly, and contains only about 2000 inhabitants, it meets the requirements of the northern district for the time being, and whatever the population may be, up to the numbers specified there will be no necessity for further expense. It pays its current expenses and a trifle more, leaving a minimum charge, namely its repayment of principal and interest of purchase-money, to be paid from the rates.

This northern district up to very lately has been to a large extent agricultural, and did not add very considerably to the rateable value. Its splendid position has, however, been recognised, and a large number of valuable buildings have been erected within the last two years. Up to the year 1876, important though the

district had become, the Local Board were without a habitation of their own, the meetings and official work of the Board being carried on in a small and comparatively insignificant building at a very trifling cost. It did, however, occur to the Board that it was time to erect a building suited to meet the increased requirements of the district, and the author was instructed to prepare plans and estimates accordingly, and to combine in the buildings, not only board-room and the various offices, but to make provision for the necessary stabling. Ground most suitably situated was procured, and offices, with the necessary accommodation were erected, more suited to the important character of the village and the growing necessities of the place. It is almost unnecessary for me to say how much this erection has added to the comfort of not only the Board, but those who have to carry out the daily work connected therewith.

Up to this time the whole of the Board work had been done by contract, and although there was a diversity of opinion as to the desirability of purchasing horses for the ordinary work of the Board, this was at last done, and I now bear testimony to the fact that the entire cost of the horses was saved within the first twelve months.

Another point of interest to which I would direct particular attention is as follows:—All persons visiting our village are naturally pleased and surprised at the large amount of open space which has been obtained for recreation within the last ten years. The Board have become proprietors of all the open public greens and commons in the district, viz.:—The Common, Haven Green, Ealing Green, Drayton Green, and the waste slips bounding some of our principal thoroughfares; and more than this—in the last year they purchased the freehold in the Lammas Lands, adding some thirty acres to be retained in perpetuity, for the recreation of the people, in addition to the amount previously acquired. The extreme value of this can hardly be seen at the present moment, but a few years hence, when Ealing shall have become three times more populous than it is to-day, this forethought and provision made by the Board will be recognised and valued to its full extent. You may depend upon it there is no investment that a public body can make more valuable than the securing of open public spaces, which will prove a boon, not only to the present, but to generations yet unborn.

Now let me turn to the subject of roads, already referred to in connection with the old Highway Board, and the work done upon its decease, and detail a few particulars as follows:—The total length of roads throughout the district, public and private, is 33¼ miles;

of this quantity 14½ miles have been made by private owners. Since the formation of the Board, 5½ miles thus made have been taken over by the Board under the 152nd section of the Act, and are now repairable by the ratepayers at large. Our main road, which costs us between 800*l.* and 900*l.* per mile, is paid for partly by the county rate and consolidated fund, the other portion by the ratepayers. About five miles of roads are macadam, the remainder are flint or gravel. All new roads in the district are completely kerbed, channelled, and finished with flint before the houses are allowed to be erected. Exception has been taken to this by the land societies (those curses of modern civilisation and suburban districts), but their objections have no effect whatever upon the opinion of the Board, and I may add, by way of parenthesis, that the Ealing Local Board and their Surveyor are not looked upon with any kindly feeling by the majority of these societies. This, however, is a matter which does not trouble us in the slightest degree; they need not come to Ealing without they like, and if they do come they must conform to the Ealing laws. Where it is possible, in connection with these roads, to lay down a separate sewer for surface water, it is done, and in every case the lamp-posts have to be fixed at the expense of the owners. The streets are kept in repair till the buildings are completed, by the owners, but the lighting is paid for out of the public rates.

There are many things in connection with the growth of the district, such as the one I now represent, I should like to have touched upon, but find that time would fail me in a meeting such as this to give fully, or even glance at, the many subjects of interest which are associated with the development of a suburban district. Our Fire Brigade, which in the early time of the Board was represented by an antiquated squirt, is now divided into three efficient divisions, having a steamer, two manuals, and two fire-ladders, fixed at different points of the district, and comprising in all thirty-six men. These are all volunteers. You will notice, also, in passing through the village that the planting of trees is a matter to which considerable attention has been given. To a certain extent the erection of houses must destroy the rurality of the place. The Board endeavour to compensate for this by planting trees wherever there is an opportunity. Before turning to the question of the works which we are about to view, and without wearying you with a tabulated statement, I would answer the question which I know full well has been mooted by more than one in this room, viz. what are the results in a sanitary point of view of the work which has

been done? And the reply is one which I think must commend itself to every gentleman present.

I cannot go back farther than the year 1876 (when the Medical Officer was appointed for the district) to give you statistics of the death-rate, but from that date they are as follows:—

1876	18·26 per thousand.	1880	12·2 per thousand.
1877	15·84 „	1881	12·4 „
1878	18 „	1882	13·9 „
1879	15·5 „	1883	11·23* „

giving an average for the past four years of only 12·9. I believe I am correct in stating that nothing more favourable can be produced in any inland town in England having a population of 18,000, than the statistics I have given you of the death-rate of Ealing. Another table might have been a matter of interest too, but to save time I will put it into a few words, viz. the amount of money we have expended in the whole of our sewage works, purchase of land, providing offices, recreation grounds, horses, fire-engine and machinery, and the hundred and one matters which have sprung up within the last twenty years, reaches a total of 81,520*l.* Taken for that period it represents a little over 4000*l.* a year. We have repaid a sum of nearly 30,000*l.*, leaving a debt of rather more than 51,000*l.*, whilst we have now a rateable value of 118,000*l.*, a condition of financial prosperity which you, gentlemen, will fully appreciate, knowing as you do how many towns there are whose debt exceeds three-fourths, and in some cases the whole of their rateable value. The natural consequence of so much money having been paid off, and the rateable value increasing rapidly is, we are able to do with a comparatively low rate. Since the year 1879 we have never exceeded 1*s.* 6*d.* in the £ for the half-year. At the present time we are about to erect an Isolation Hospital. It may seem somewhat paradoxical, seeing the healthy state of the district, and the wonderfully low death-rate, but the Local Government Board have expressed a wish that we should be prepared for any emergency that may arise. We know that to be forewarned is to be forearmed, and to be able to meet promptly and advantageously is the readiest way to mini-

* Ealing, as compared with several of the best known health resorts in England, stands out pre-eminently as a healthy district. The following record of Death-rates, from the returns of the Registrar-General, fully confirms this fact:—

Tunbridge Wells	14·6	Penzance	16·9
Weston-super-Mare	14·6	Torquay	16·9
Eastbourne	14·88	Teignmouth	17·5
Harrogate	14·9	Cheltenham	18·4
Hastings	15·85	Scarborough	18·84

mise any evil that may come upon us. We have procured a site of land, and the drawings which you see upon the walls illustrate the building as proposed to be erected, and which we hope will be a model isolation hospital. Before another year we also anticipate erecting public baths, which it is unnecessary for me to say will be second to none. We have already adopted the Public Library Act, which is a great success. The Model Bye-laws of the Local Government Board, with certain modifications, were adopted in 1880, but as there are several clauses which would work better with some slight alteration, the Board are about to apply to the governing body for their sanction to such alterations. I need hardly say how important a bearing the thorough carrying out of these bye-laws is having upon the class of houses now being erected in the district, and to the very simple yet now well recognised fact, that the jerry builder has discovered that Ealing is a very uncongenial place in which to carry out his building operations.

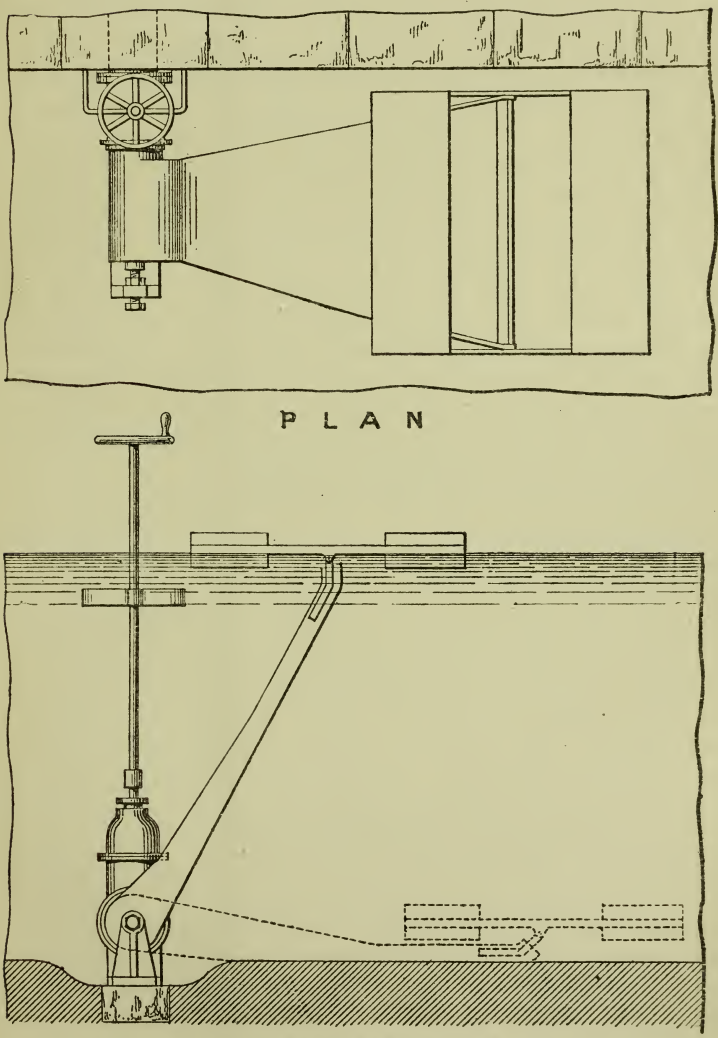
Upon the question of sewer ventilation I think it is hardly necessary to make any remark. It has been often discussed, and one is almost tired of hearing it. I would simply state that the sewers of Ealing are laid in straight lines, ventilated by manholes at every junction, and by ventilating shafts at varying distances, as circumstances require. We also adopt the upshaft pipe wherever a tree can be made use of, and so utilise as far as possible this admirable means of ventilation. But few difficulties have arisen in connection with this subject. The most striking one I can remember during my twenty years' experience in Ealing was remedied, not by stopping up the manhole, as you remember was suggested at a meeting not long since, but by constructing another manhole within 50 yards. A systematic flushing of the sewers in the district is kept up, particularly during the summer months, and we have a means in connection with the office establishment of deodorising the sewers, this arrangement being entirely independent of any of the workmen, other than the office-keeper, who lives upon the premises.

I might finish this paper here, and give a description of the Southern Works when we are upon the spot, but probably it will be more convenient if I just say a few words which you will bear in mind as we go over them. As before stated, the works were constructed originally for precipitation, subsequently lime was used and the tanks were enlarged. A few years later the growth of the population required a still further enlargement, and for a time lime and a salt of iron was used, which latter was manufactured

upon the premises. I, however, fell back eventually upon the milk of lime, which, notwithstanding the various schemes which have been propounded, continues to be my favourite mode of dealing with the sewage. In making these remarks, it must be borne in mind that I would use lime whether I had land for final purification or not. In the several works which I have designed in different parts of the country, it has been a *sine qua non* with me that disinfection and clarification by lime in receiving tanks shall precede the final purification by land. At the Ealing Southern Works there is no land. For many years we had but one acre to do all our work upon; two acres in addition were acquired some two years since, upon which additional tanks have been erected, and the effluent flows away directly to the river Thames, in a condition I think sufficiently pure for the river into which it passes. Further purification is simply a question of expense, and I see no object in spending the ratepayers' money to arrive at a still higher degree of purification, unless absolutely called upon to do so. You will see, however, at the works, that I have added somewhat to my purifying material. The sewage, as it passes into the old tanks, is met by a small amount of clay, the effect being merely mechanical, and bringing about precipitation more rapidly than ordinary lime would without it. The milk of lime is added after much of the solid matter has been deposited, and consequently a minimum amount is required, and you will further notice, after passing through the first new tank on the lower level, the water is there met with a solution of aluminoferric. This precipitates a very large amount of the matter still in suspension, and fixes to some extent the gases, preventing the inconvenience which was formerly felt when the tanks were emptied. From the time when the sewage enters the works to the point where it falls over the tumbling bay into the outlet sewer, it traverses a distance of something like a quarter of a mile. Personally, I prefer this method, although there are those who prefer settling tanks, the water being siphoned off. We have the means of doing this, inasmuch as each tank is fitted with a "floating arm" (Fig. 1), by which the water can be lowered to within 18 inches of the bottom. These are used occasionally, not continuously. I prefer the mode first described. We will now turn to that which is, I know, an important and perhaps a principal matter in connection with your visit here to-day. In all districts where the sewage has had to be dealt with by precipitation, the difficulty which I have felt has

EALING SEWAGE WORKS. Fig. 1.

Sketch shewing Floating Arms, as used at the Works.



PLAN

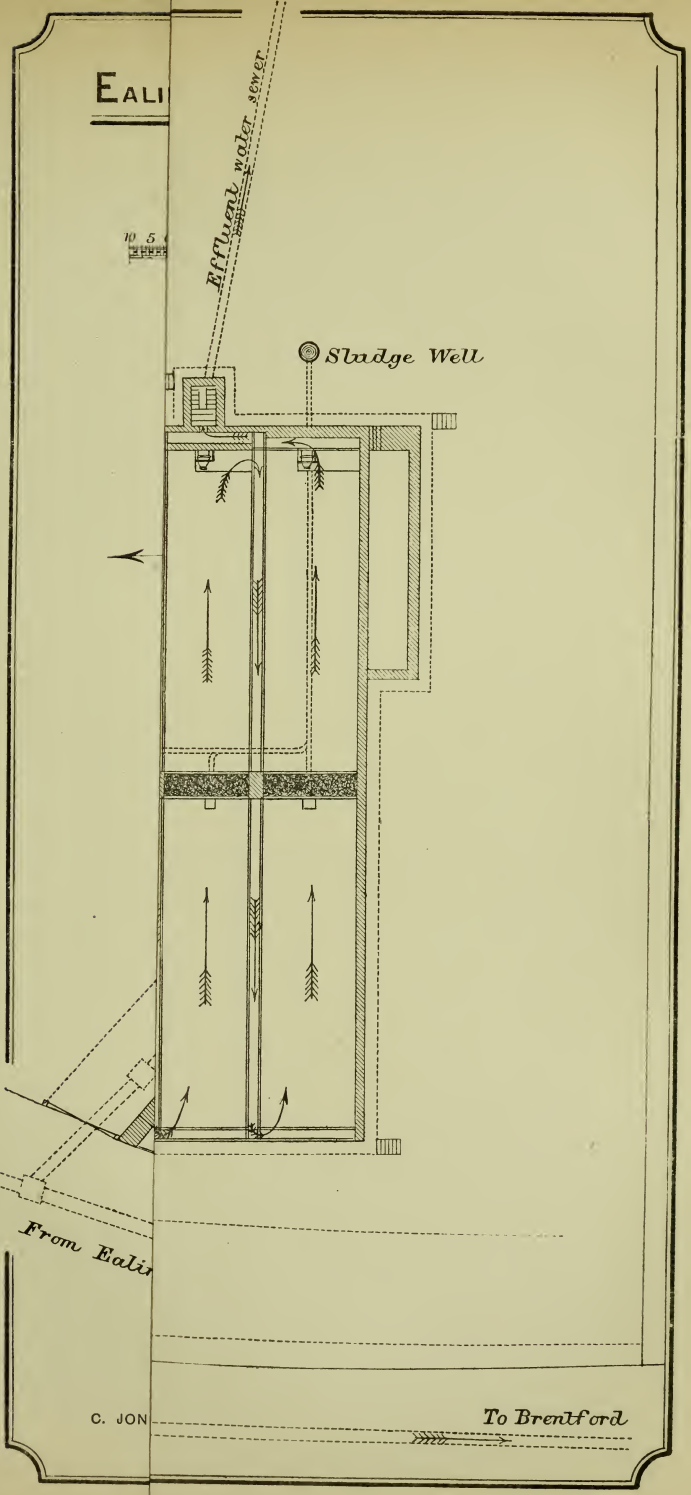
ELEVATION

BROWN & BOBY, MAKERS, LONDON.

C. JONES. C.E. EALING.

been realised, and it was this difficulty which led me to turn my thoughts some years since to the possibility of so treating the sewage sludge as to minimise the evil, or, in fact, remove it entirely. It was during the visit of our Association to Leeds in May 1880, under the presidency of our lamented friend, Mr. Morant, the Borough Engineer of that town, that my attention was particularly directed to the possibility of utilising the destructor not only for the purpose of combustion, so far as house refuse was concerned, but also in dealing with the still more troublesome question of sewage sludge, for although the question is not one so apparent to individual members of the community as the "dustbin" nuisance, it is one far more difficult to deal with, and has probably taken up more pages of blue book literature than any other subject during the past twenty years. It has been usual with us to mix our sludge with the house refuse after taking out the rougher materials, such as pots, kettles, &c. For some years this mixture was readily taken by the farmers in the neighbourhood, who paid us a small sum per load for the material. Gradually, however, as farmers and arable land became scarce, and bricks and mortar took the place of corn, the difficulty of dealing with this material grew very rapidly.

The little ground that was left in the neighbourhood upon which farm produce was formerly grown was taken up by market gardeners, who had no great love for this material, for although the land was somewhat heavy, cabbages and plants of that character are not benefited by cinders and ashes, consequently we were compelled to alter somewhat our mode of mixing the material. Eventually the demand became so small that we had to look the difficulties of the case fairly in the face, and endeavour to find a remedy. This remedy I unhesitatingly state has been found in the use of the destructor. I lay no claim to anything novel; the destructor has been used for some years in the north, and I am only surprised that its application and suitability was not more readily seen. Its utilisation in the particular way in which we use it, is, I believe, a new application of its powers. So far as the mixture is concerned, we do now exactly as when the farmer took our material; the ashes are formed in what we call "stanks," the sludge is emptied into these stanks and mixed with ashes, and the material drains itself so as to be just movable, and in that condition it goes into the kiln. Everything of an organic nature is destroyed, and we get a residuum of hard clinker, about 25 per



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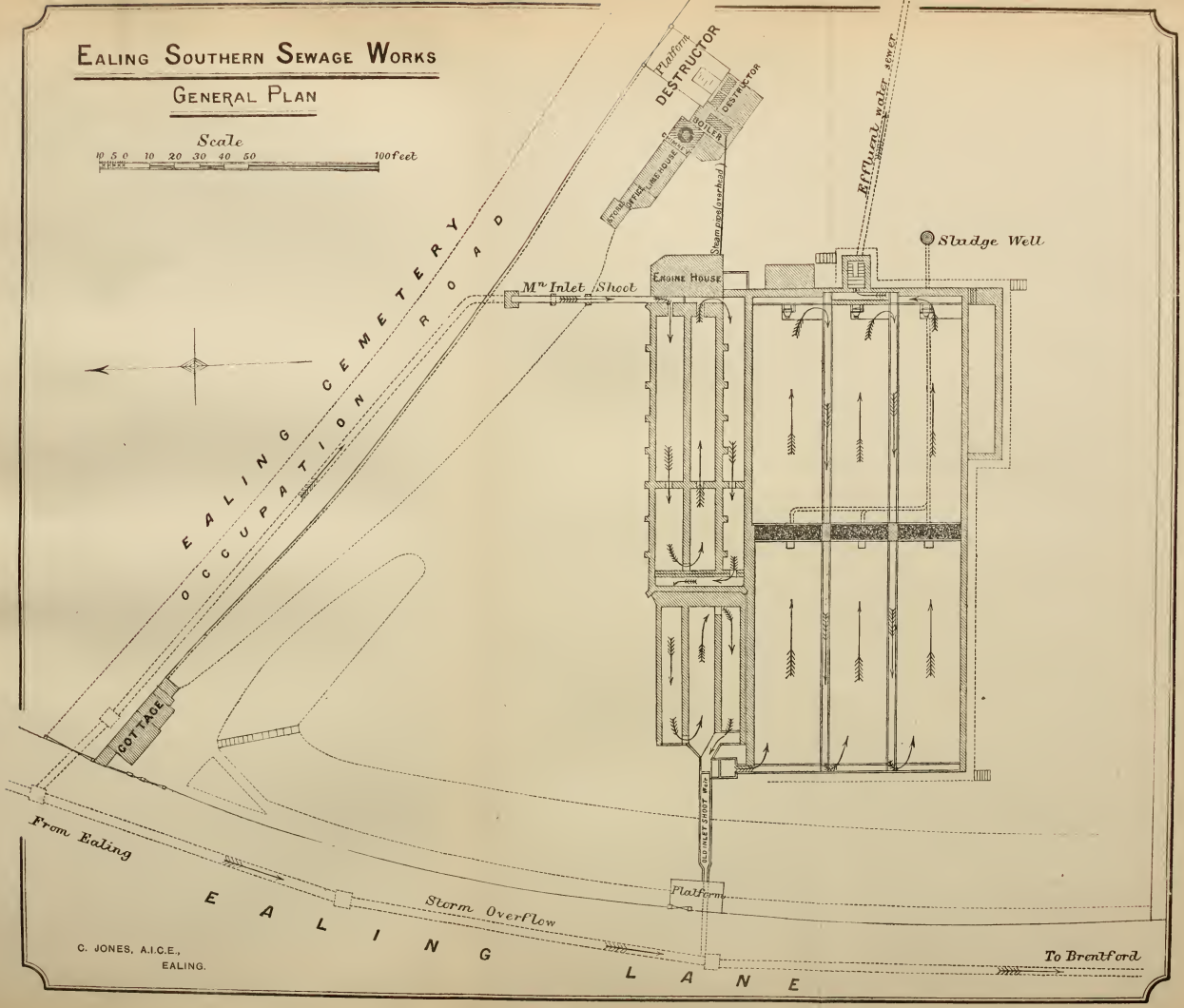
EALING SOUTHERN SEWAGE WORKS
GENERAL PLAN
Scale
10 5 0 10 20 30 40 50 100 feet
EALING CEMETERY
OCCUPATION ROAD
COTTAGE
From Ealing
EALING LANE
Storm Overflow
C. JONES, A.I.C.E.,
EALING.
Platform
DESTRUCTOR
DESTRUCTOR
BOILER
STORE
OFFICE
LIME HOUSE
Steam pipe (overhead)
Effluent water sewer
Sludge Well
ENGINE HOUSE
Mn Inlet Shoot
SLUDGE INLET SHOOT
Platform
To Brentford

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cent. of the material deposited in the kiln. This residuum is valuable for various purposes. We are accumulating it now for road-making. It is also ground into sand for builders' use, to which it is most admirably adapted. It makes excellent mortar, and in these various ways becomes a source of revenue instead of continual expense.

On the question of nuisance arising, I must distinctly say there is nothing for any nuisance to arise from in the use of the destructor. On only one occasion has any injurious effect arising from the use of the apparatus been discovered, and for that there was a cause, namely, the furnaces had been kept alight too long; having been used without intermission for three months. The only difficulty which I really find is that I have not sufficient cells to do my work thoroughly, and no doubt before very long it will be necessary to work two or four more cells. This is not a matter of great expense, as the principal work has already been done. The shaft, which is 143 feet in height, is suitable for a dozen cells should they be required. The boiler fixed in position is also an expense completed, and the same may be said of the engine and mortar mill connected with it. I consider, properly fixed and properly worked, it would save in a moderately large establishment all cost of fuel for boiler purposes. I may add that the experiment thus carried out at the Ealing Works in connection with the destructor has attracted much attention in various parts of the Home Counties, and especially in the vestries connected with the Metropolitan Board of Works.

The dustbin nuisance and the difficulty of finding suitable tips is growing day by day, and I have no doubt that the destructor will be very much used for the purpose indicated. To some of you, however, its application as a sludge destroyer may be more important than in any other light, and I cannot but again express my conviction that it is a simple and ready means of dealing with this difficulty.

In conclusion, I must not omit to state that in the "twenty years' development of this suburban district" matters other than sanitary have not been forgotten—for whilst we have spent some 80,000*l.* in the works to which this paper has had special reference, a sum of money not less than 60,000*l.* has been expended in the erection of churches, chapels, schools, and other buildings appertaining to the intellectual, moral, and religious development of the people of Ealing.

SKETCH OF THE GEOLOGY OF EALING AND ITS VICINITY, WITH EVIDENCES OF GLACIAL DEPOSIT.

By J. ALLEN BROWN, Esq., F.R.G.S., &c., &c.

The connection between all branches of science is so fully accepted, that it would seem almost superfluous to allude to it here, if it were not that the pursuit of the one to which, perhaps, all our attention and study is devoted, becomes frequently so absorbing, in order to keep pace with other workers in the same field, that we are likely to lose the advantage which may, perhaps, be obtained from the thought and observation of those whose labours have been in other channels. In other words, the concentration of thought, now so necessary for the achievement of success in our own work, compels us often to forego, perhaps unwillingly, the consideration of those facts a little outside our line of thought, which, if time could be given to them, would often prove of great service to us.

It is from this point of view that I am led into the consideration of the Geology, and chiefly the Pleistocene or Quaternary deposits of this district, in relation to the work of your excellent and important Society, to which my attention has been drawn by your able and energetic Past-President and present Hon. Secretary, Mr. Charles Jones, C.E.

Let us, then, glance at the physical geography and geological aspect of the hills and valleys about us, and notice the strata of which they are composed, and the facts relating to those strata in this neighbourhood.

These strata belong to the Eocene as well as the Pleistocene or latest geological period, and their past history may help us a little more fully to understand them; while a few general remarks, of some interest to many whom I have the honour to address, may form a fitting sequel to this cursory sketch.

We will first consider the ground beneath us, and the order in which the strata are met with in boring for wells, in reference to which in this locality I have entered more fully in a paper on the

"Water-bearing Strata of the Ealing District," read before, and published by, the Ealing Microscopical and Natural History Society in 1882.

1st. We have alluvium, gravel, and sand, or the Thames Valley deposits, which will be chiefly considered in this paper.

2nd. The London clay; a marine bed with evidence of proximity to a large land surface.

3rd. The Oldhaven or Blackheath pebble beds; an ancient beach deposit which does not extend so far to the west as Ealing.

4th. The Woolwich and Reading beds; they are largely composed of mottled clays and sands, with hard coarse sandstone and conglomerate, green and yellow sands with comminuted shells, and dark blue clay near the bottom, containing often shells, bones, and leaves. I mention the characteristic features of these beds because they are widely distributed in the London Tertiaries, and almost constantly occur between the chalk and the London clay. This is an estuarine deposit, abounding in brackish and fresh-water mollusca, and the near vicinity of the land is further shown by the occasional discovery of land shells and mammalian remains.

5th. The Thanet sands; formed largely of ferruginous sands and pebbles, with ash-coloured sand, often slightly micaceous. They are more easily identified by the thin stratum of greensand and green-coated flints which is found at the base. This deposit thins out to the west of London, as shown in well sections, and probably disappears altogether at Ealing.

6th. The Chalk. This, as many of you are aware, forms a large source of water supply in certain districts near London. The populous districts of Deptford, Greenwich, Woolwich, Plumstead and Charlton, and the adjacent districts, are supplied by the Kent Water Company wholly from this source, and the report of the public analyst, Dr. Frankland, invariably gives this water a higher character for drinking purposes than that obtained by the other companies from rivers. According to a useful little book ('Geological Rambles Round London,' written by Mr. R. E. Bartlett, published by Marshall, Japp, & Co.), the Kent Water Company now derive nearly twelve millions of gallons daily from their wells. I shall have to refer to this subject again; at present it is only necessary to point to the fact that the chalk is a large unused source of water supply in north-west Middlesex.

After reaching the chalk the information derived from borings comes to an end in north-west Middlesex, with the exception of

that obtained from the deeper wells sunk at Kentish Town and Meux's Brewery in Tottenham Court Road, where the following strata were shown to occur :—

7th. Upper Greensand.

8th. The Gault.

9th. The Lower Greensand, which would appear to thin out to the north-west of London; and

10th. The old or Palæozoic rocks, whether of Triassic or Devonian formation, a ridge of which is supposed to underlie the Thames valley, extending from the west of England to Belgium; these have given rise to much speculation concerning the existence of coal in this direction, arising from Mr. Godwin Austen's argument that the older rocks, exposed in the Ardennes and the Mendip Hills, are parts of the same elevated formation, and that they are connected underground nearly along the valley of the Thames. There has as yet been no proof that true coal measures occur.

Having descended into the earth's crust by these borings to the extent of 1302 feet and 1144 feet respectively, and referring my hearers to a section across the London basin showing the probable ridge of old rocks, which will be found in Mr. Whitaker's 'Guide to the Geology of London and its Neighbourhood,' published by the Geological Survey of England and Wales, and to an excellent article by Professor Prestwich, which can be seen at page 912 of the 'Quart. Journal of Geol. Soc.,' for the year 1878, it will be well to come to the surface again and notice what the Thames valley is in which Ealing is situated. The Thames valley has been called a basin, but that useful article of domestic furniture conveys but a very imperfect idea of what it really is; it is, in fact, a wide shallow trough about eleven miles broad at its maximum, the bottom of which inclines gradually both on the north and south towards a long furrow, which represents the Thames; this gradual inclination is a very important element in its formation, both from a sanitary point of view, as it affords a grand system of natural drainage, and also from the fact, of which there can be no doubt, that the fertility of the soil and its productiveness is thereby increased.

The margin of the trough both north and south is much broken and indented, and the gradual slope of its bottom is interrupted by ridges of low-lying hills, the elevation of which is insignificant (the maximum is 430 feet) as compared with the width of the trough. The ascent of these hills is always gradual, and there are no escarpments.

These slight elevations contain records of a geological history which would otherwise be lost, and we shall consider them later on.

The trough of London Clay appears to lie in a depression of the Chalk, and the depth of the Tertiary strata decreases as the chalk hills on the north-west are approached from Ealing; thus, if we take a line between this district and Ruislip, which is near the rim of the trough, the borings to the Chalk in that direction are, say, Ealing, 300 feet; Northolt, 180 feet; Ruislip, 76 feet. Again, taking another line, we have Ealing, 300 feet; Hanwell, 290 feet; Southall, 252 feet; Hayes, 252 feet; Uxbridge, 109 feet: and this evidence in favour of the successful boring of artesian wells might be multiplied. In fact, the London Clay and Lower Tertiaries lie in a synclinal curve of the underlying Chalk deposits, a position very favourable for well sinking, and as the bands of flints, joints, and fissures, which abound in the Upper Chalk are great aids in retaining and collecting the water, there seems to be little doubt of a good supply being obtained.

The fact that a bed of flints is of great service to the well sinker is illustrated by an old boring at the Bishop's Palace, Fulham, where, having sunk 250 feet through the Tertiary beds, and 65 feet into the Chalk, the contractor came to a bed of flints, from which water flowed above the surface to the amount of 40 gallons per minute. Borings at Hanwell afford the same evidence.

These are important facts in reference to the possible future supply of water for this district. We have only to tap the Chalk in several places at or near Ealing, and connect the wells with a suitable reservoir, to obtain a larger quantity probably than is required; and the same may be said of other towns within a like radius.

For the best information in reference to well borings, as well as to the geology of the London basin, I must refer my hearers to the books of Mr. W. Whitaker, of the Geological Survey, viz. the 'Geology of Parts of Middlesex,' 'Guide to the Geology of London,' 'Geology of the London Basin,' &c.* Mr. Whitaker has published the largest list of borings to the Chalk, and his works contain the fullest information on the subject.

Having considered the under part of the trough lying on the Chalk; let us now examine the surface of it. To do this conveniently

* And also 'The Water Supply of England and Wales,' &c., by Mr. C. E. De Rance, F.G.S., of the Geological Survey; and on the same subject by Professor Prestwich; Mr. W. Topley, F.G.S., Geological Survey; W. J. Harrison; Lucas ("Chalk Water System": Proc. Inst. Civ. Eng., vol. 47); &c.

we will approach the north-west rim from Brentford, taking our Ealing district on the way. Leaving the water of the Thames in this direction we shall first meet with low-lying marshy meadows, which in time of floods are submerged, when silt or brick earth is in course of being deposited upon them. Then we shall come to beds of brick earth with very thick deposits of gravel beneath them; long stretches of gravel then intervene slightly raised above the last, often with patches of sandy clay or brick earth upon it, indicating that the surface was once spread over with that deposit. At Castle Hill Station, the gravel is exposed on the surface and is of the depth of more than 20 feet. This thick bed of gravel extends to the north high up the shoulders of Castle Bar Hill and the high ground north of Ealing Common, though it is covered in these localities with brick earth to the depth of 10 and even 11 feet, and it may be noticed as far to the east as East Acton, where it is bounded to the south and east by a wide deposit of brick earth, and by London clay to the north, from which the river deposits have probably been washed or denuded.

This bed of gravel underlying the brick earth is interstratified with loamy sand and sandy clay; and a stratum of sharp sand, which occurs at a depth of from eight to twelve feet, ends invariably at the base in very large stony gravel containing nodules of flint abraded, yet many of them still retaining their white crust, indicating that they have not travelled so far or been subjected so long to the wearing action of water as the large water-worn rounded masses of quartz, quartzite, and other rocks foreign to this county, with which they are associated. Large boulders of Sarsen or Greywether occur, a tough sandstone of the Bagshot series, deposits of marine origin which once covered the London clay throughout its extent, but which have since been washed and denuded from its surface, leaving a large patch in the district from which it takes its name, with outliers at Highgate, Hampstead, and Harrow, as silent testimony to the former extension of the beds, and witnesses to the great denudation that has taken place in the ages which have passed away since the marine formations of the London Clay and Bagshot Beds in Middlesex formed the dry land in the Miocene and Pliocene epochs.

The coarse stony deposit I have described always forms the lowermost bed of the gravel, and is, in fact, the water line on the London Clay; as Mr. Whitaker says, "These beds of gravel, sand, and loam, formed after the great Ice age (to which we shall again

refer), with its deposits of boulder clay, had passed away, when the climate, though not so mild as now, had sensibly changed for the better, may be looked upon as the forerunner of present conditions, the sign of the better times that were to succeed."

The river, which then flowed high up the shoulders of the hills in this vicinity, and even in times of flood to the top of Castle Bar Hill, as shown by the deposit of three or four feet of brick earth which I have found there, must not only have been much wider, but from the coarseness of the material deposited on the London Clay, it must have been more rapid and stronger before it had eroded the valley to its present depth. There is no doubt it was traversed by large masses of ice, evidence of which is seen in the boulders of Sarsen stone, which are found weighing five to eight cwt. and must have been borne thither by sheets of ice floating down the streams; a large mass of this sandstone is now in my garden, found at the depth of 18 feet in the Albany Road, Castle Hill, which is about 125 feet O.D.

The power of the river was probably increased by greater rainfall, as Mr. Whitaker suggests, and "by greater liability to floods, both resulting from a greater elevation of the land and a colder or more continental climate than now holds," "it had a more torrential character than the present quiet stream, and therefore was endowed with greater erosive and carrying power."

There is much evidence that this ancient Pleistocene river, compared with which the Thames at Brentford is but an insignificant stream, with its tributaries, scoured out its channel or trough from more than 130 feet O.D. to its present level while the land was rising, and there can be no doubt that this process was brought about by the double erosive action which is characteristic of running water.

This work consists, first, in scouring out or deepening the bed of the river; and secondly, by the cutting away of the banks by the force of the current on the outside of each bend: the more rapid water of the outside of the bend scouring out, while at the opposite bank, where the current is slackened, the deposition of matter took place. In this way the river gradually shifted its position, now eroding and following the north, and then afterwards a more southerly direction in its changing course. The remains of its old terraces, or former levels, which are generally divided by strips of London Clay, are evident.

Colonel Lane Fox, now General Pitt Rivers, has carefully

traced them in relation to the discovery of flint implements;* and Mr. Whitaker† has divided them into three terraces, viz. a high terrace occupying the sides and shoulders of the valley at a height of 50 to 100 feet O.D., but which I have traced in this district to a height of 130 feet O.D.; a mid-terrace from 20 to 30 feet high in the bottom of the valley; and a low terrace occupying the low ground in the salient bends of the river at an average height of from 10 to 20 feet. "The lower margin of the mid-terrace gravel runs from the river at Kew by Chiswick House to Chiswick, where it again joins the river; all below this line in the bend of the river is the third or low terrace. In the next bend of the river Mr. Whitaker has traced it along the river below Hammersmith to Fulham Church, and thence to Sandy End and Walham Green."

The high-terrace gravel has been traced from Drum Lane, north of Brentford, passing a little below Gunnersbury to Acton and East Acton, where it ends off; and the next or mid-terrace runs up at Wormwood Scrubs as far as the London Clay. "The northern boundary of the high terrace extends to beyond Hanwell on the west, passing by Ealing to Acton, where it is cut by a strip of London Clay in the ravine of the Acton Brook, dividing it from the isolated patch of high-terraced gravel to the eastward." I have, since the publication of this memoir, traced it up to 130 feet to the north of Castle Hill Station—and brick earth or loess on the top of Castle Bar Hill itself—so that at this period in the history of the river, a person standing on Castle Bar Hill would have seen its waters flowing within 150 yards of him, and spread out, perhaps, for miles on the south as a shallow stream, with a great increase in its width in times of flood. The Brent Valley and low-lying country to the north was perhaps also submerged, and Horsington, Wembley, and Harrow Hills, &c., may have presented the appearance of islands. The patches of gravel which occur north of Twyford, and other isolated patches, including those in the valley of the Brent, may have been, and probably were, the remnants of the deposits of the wide Pleistocene river, re-deposited by that little, pretty winding stream which, meandering on its picturesque course through the meadows to the north, affords us a good illustration, by its noticeable old channels and terraces, of the same river action which has scoured out the valley to the south.

* 'Quarterly Journal of the Geological Society,' for November, 1872.

† 'Memoirs of the Geological Survey of Great Britain,' sheet 7 of the Map of the Geological Survey.

We will now examine some of the higher hills in this vicinity. They have been denuded and wasted by the action of rain, air, and frost, those giants which are always at work altering the physical geography of the world, and whose work, unceasingly in action for countless ages, may be traced even from the period when these eminences did not exist as hills, but formed part of a plain sloping gently towards the Thames, or a still more ancient depression into which the waters flowed when the ice and snow-clad land gradually rose from the sea during the last Glacial period. To understand this thoroughly, we must take another step backward in time. We know that during a part of the last Glacial epoch, the whole land of Great Britain and Ireland was sunk below the sea level, and formed part of the sea bottom; the waters overcame it slowly, until none but the highest peaks of the Welsh, Scotch, and Irish mountains were visible, as islands. Marine shells have been found near the summit of Moel Tryfaen, near Carnarvon, at an elevation of 1170 feet, and near Macclesfield at 1200 feet, near Congleton at 600 feet, and in glacial drift in Ireland at 1200 feet, and there are many other proofs of this submergence. These shells are nearly all of Arctic species, such as are found now within the Arctic circle.

At this time the great boulder clays were spread out on the sea bottom, containing transported rocks from the north, dropped by the icebergs as they melted (a good example of which can be seen at Finchley), which floated obedient to the currents and winds, as they do now off the coast of Labrador and South Greenland.

We have evidence that the next change was one of re-elevation, and that our country gradually rose, the sea apparently slowly retreating from the land, until it not only assumed its present limits, but the British Isles became united to the Continent, which would be the case with an increased elevation of 600 feet from the present level, and the rise was greater than that; the rolling waters of the North Sea and German Ocean gave place to an undulating, woody country, watered by rivers and many lakes, extending to Denmark, while the west coast of Europe, being extended by its increased elevation on the south and west, became united to the continent of Africa. Those who desire further information on these changes should consult the works of Lyell, Professors Ramsay, Geikie, Rupert Jones, Dawkins, and other authorities on the subject. The evidence is largely obtained from soundings, which show that the British Isles may be regarded as an elevated plateau, bordered by a steep slope on the west, descending from less than 600 feet to 10,000 or 12,000 feet;

and the depth of the German Ocean, North Sea, and the English Channel never exceeds 500 feet. The continuity of this country with the Continent is further shown by the great influx of Arctic animals, driven hither by the still greater cold of northern Europe which then took place, and the evidence derived from the flora is of the same character.

The great Pleistocene river, which is now only represented by the Thames, whose high-level gravels I have described, then rolled its rapid course into a still more mighty river which flowed through the North Sea and German Ocean into the Arctic Sea; while the Rhine, Weser, and Elbe, and the rivers of the north of England and Scotland, fed its vast volume as tributaries.

The sea bottom, as it rose, was of course covered with the débris of the transported rocks and clayey matter, derived from the moraines of the great glaciers of the north, which had been dropped by the icebergs as they melted, just as the same effect takes place now in the North Atlantic; and it was through this deposit of sea gravel and moraine matter that the river first flowed, whose re-deposited gravels, by river action in this locality, I have described. Sands and gravels, which, taken in conjunction with the form of the valley and the excellent sanitary arrangements made for the past twenty years by Mr. Charles Jones, have had the effect of reducing our death-rate to 11·23; a rate which is a testimony alike to the healthy position in which Ealing stands, and to the care taken to preserve these advantages by our Local Authority and their Engineer.

The surface of the land has been scoured by river action. The ice and snows slipping to lower levels, in that semi-glacial period, have washed and worn it, and blocking and damming the streams at times may have produced, as Professor Rupert Jones suggests, a succession of minor deluges; and the crumbling by sub-aërial action (there seems to be little doubt that there was then a greater rain-fall) have helped to denude and alter it, but the hills remain as witnesses to these changes. They are wasting away, and will waste away, by the operation of similar forces until they are utterly gone. Tennyson says truly:—

> "The hills are shadows, and they flow
> From form to form, and nothing stands.
> They melt like mists the solid lands;
> Like clouds they shape themselves and go."

There remains enough, however, to tell us something of their past history, and of the Glacial epoch so briefly described in this paper.

There is still at the top of most, if not all, the hills about here —on Horsington, Castle Bar, Hanger Hill, &c.—indications of glacial drift, while on the Mount I have had abundant evidence afforded me of its occurrence in the excavation made about a year since for a large reservoir by the Grand Junction Water Company, where every facility was given me for the examination of the sections by the kindness of Mr. Fraser, Chief Engineer to the Company.

The Mount is about 210 feet above the O.D., and the surface of the field where the excavation was made is strewn with a profusion of sub-angular and much-weathered flints of true glacial type—some of the nodules still retain their white crust, and have not passed through the gravel conditions. Interspersed with these are rock specimens of various ages and all sizes up to nine or ten inches in diameter, and of the forms characteristic of ice-borne boulders, some of which show traces of glacial striæ or scratching. In my collection from this field are specimens of quartz: quartzite (one a round, flattened boulder, 5 inches in diameter), greenstone, with veins of quartz; trap rocks; granite (one piece five or six inches across); carboniferous and cherty limestone in abundance; carboniferous shale; red sandstone; upper oolite; forest marble; lower greensand; Bargate stone, chert, chalk marl; tabular and nodular flint, Sarsen stone, and others.

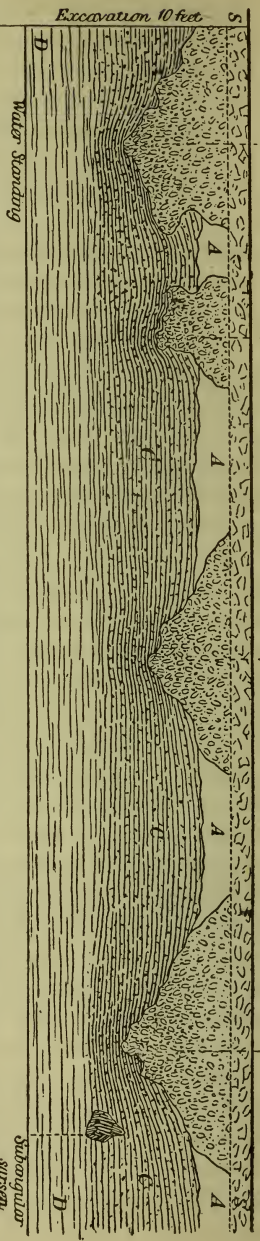
I will now refer to the section on the next page.*

The various stones on the surface descend into the channels B. The deposit A appears to be re-deposited puddled London Clay, mottled of various colours, with occasional thin layers of sand. This deposit, which is three or four feet deep, seems originally to have capped the hill, and now lies unaltered beneath the channels, and it appears to be pressed laterally where it is traversed by them.

At B is shown the irregularly-formed jagged channels, and from the correspondence I have been able to trace in them on each side of the excavation, I estimate these furrows at 130 to 150 feet long, extending like grooves four or five feet deep into the original surface. In these channels, as seen in section, is a very pebbly gravel, with angular and sub-angular pieces of chert, quartz, quartzite, &c., extending to the surface, but distinctly crowded into the depressions and more scattered higher up. They resemble the pebbles and boulders I have already described as being spread over the fields. The channels have the appearance of having been scooped

* The woodcut is inserted by the kind permission of the Geologists' Association of London.

out by some angular mass, and afterwards filled in with gravel and the débris of various rocks.



Underlying these channels is a stratified bed of loamy clay or sandy clay, of buff or yellow colour, some bands being nearly white, and all being deposited very regularly, except where the depressions or furrows occur; there the many lines of stratified loamy clay and sand follow the form of the channels, and are distinctly pressed out of the line of deposit. The nearly horizontal lines being close together under the furrows, and very much bent beneath them, often break up the strata into a curved pie-crust structure.

This effect is probably due to large masses of ice, which, stranding on that elevated land at the period of its last emergence, which I have described, and having afterwards melted, deposited beneath and around them the gravel and whatever kinds of rock they may have gathered in the north during their passage here.

The compression of the underlying strata is singularly distinct under all these furrows, which fact, taken in conjunction with the débris contained in the channels and on the surface of the land, leaves no doubt in my mind of the deposits being due to the action of stranded ice.

The deposit at D is very clayey, increasingly so as the base of the excavation is approached. It is very evenly and horizontally bedded, and contains much mica; and large iron concretions have been found in it, as

well as masses of Sarsen stone. The bed E, as shown by the results of the trial borings, is a strong loamy clay, reaching to the depth of 10 feet at least below the base of the excavation.

I have described this drift deposit rather fully, as it may serve the purpose of identifying such deposits in future by Members of your Association, and it is remarkable as being, I believe, the most southerly bed of glacial drift yet noticed in Middlesex.

In conclusion, though it is not quite within the scope of your Society, perhaps I may be permitted to say a few words as to the existence of man and the fauna which were contemporary with him at the time when the Thames valley was being excavated and the gravel in this vicinity deposited.

The presence of man at this period is attested by the discovery of flint implements, very roughly chipped, and flakes in various spots along its course; in some parts of Middlesex, as at Hackney and Stoke Newington, the floor upon which they were actually made was discovered in the gravel by Mr. Worthington G. Smith, from which large collections have been made by him and Mr. J. E. Greenhill, of Clapton.* General Pitt Rivers has found them in high-terrace gravel in the Church-field, Acton; and at Ealing Dean. Mr. Peter Crooke, of Brentford, has a considerable number from the same deposits at Ealing and the surrounding district, while my own collection of some importance from the same source is constantly increasing. Sufficient evidence is here given to show that man lived in this locality at this period when the work of scooping out the valley by our great Pleistocene river commenced; a period so remote that it can only be approximately calculated from astronomical data, having reference to the known gradual increase in the ellipticity of the earth's orbit, combined with a deviation of the inclination of the axis of our planet, which Dr. Croll† has shown to be of sufficient importance to bring about the recurrence of glacial periods at very long intervals, rather than to time as recorded in history, however ancient.

* To those who may desire to become further acquainted with the subject, the following works are of special importance:—'Ancient Stone Implements,' Dr. Evans; 'Early Man in Britain,' Dawkins; 'Pre-historic Times,' Lubbock; 'Antiquity of Man,' Lyell; 'Antiquity of Man,' Rupert Jones; 'The Great Ice Age,' James Geikie; 'Journal of the Geological Society,' Papers by Dr. J. Evans, Col. Lane Fox, Prof. Prestwich, &c.; 'Proceedings of the Geological Association,' Papers by Greenhill and others; 'Anthropological Institute,' Papers by W. G. Smith, &c.; 'Archæologia Cantiana,' Papers by F. C. Spurrell, &c.

† Dr. James Croll, 'Climate and Time.'

It is probable we may have to look to the Arctic regions for the analogue if not for the racial survivals of Archaic man in England, and find in the Esquimaux some resemblance to the earliest inhabitants of the Thames valley; at any rate he is just emerging from that condition of art culture which seems to have characterised the men of the later stone age, as he is still found using flint scrapers and other implements, until he comes in contact with more civilised people and obtains them of iron.

The bones of creatures, many of them of extinct species, while others belong to species which have long ceased to exist in England, are found in the gravels; it is rather remarkable that they are rare in the highest or oldest terrace gravel, where the flint implements and flakes are generally to be met with, but are more generally discovered in the gravel or sands of the mid-terrace and nearer the Thames.

A reindeer ford at Windsor seems almost incredible, but Capt. Louard, R.E., found the remains of the reindeer in abundance, with the bones of other animals, in digging the foundations for barracks there in 1867. Professor Boyd Dawkins tells us that he found more than one half of these bones, teeth and antlers, belonged to the reindeer, the rest to bisons, wild horses, wolves and bears; they had all been swept down by the current from some point higher up the stream. There is much evidence of the same kind in this neighbourhood. The hippopotamus has been found at Ealing Park,* (mid-terrace), and at Brown's Orchard, Acton, General Pitt Rivers found the remains of the following animals:—The small-nosed rhinoceros, horse (*Equus Caballus*), hippopotamus, bison, fallow deer, stag, reindeer, grisly bear and mammoth (*Elephas primigenus*).

At Kew the remains of reindeer have been found in considerable abundance, as Professor Dawkins tells us, "in association with the bison, and in London with the lion, Irish elk, bison, urus, horse, woolly rhinoceros, mammoth; straight-tusked elephant (*E. antiquus*), and hippopotamus."

These are but illustrations of the fauna existing at the time when man lived in this valley. A large number of the species, such as the mammoth, woolly rhinoceros, grisly bear, reindeer, &c., were animals habituated to a cold climate; they show that more rigorous climatal conditions then prevailed, but that it was gradually yielding to those of a more temperate character.

* Remains of which are, I believe, now in the very large collection of Mr. T. Layton, F.S.A., Kew Bridge.

Amidst such a fauna, and under such conditions, then, Palæolithic man lived in this valley. Clothed in reindeer skin, or the hide of other animals, leading a wandering life on the banks of the wide Pleistocene river, and but imperfectly armed with his flint-pointed spear and flint tomahawk, or "hâche," effectually to resist the wild animals with which he was surrounded, he was nevertheless able by his skill in the use of them, no doubt to provide himself with food and clothing by hunting.

The appliances for his engineering work were rude and few indeed, and it is probable that his ideas never soared beyond the building of a mud wigwam, the barricade at the entrance of his rock shelter or cave, if he could find one, and the rude defences of wattle he may have constructed. I will not go into his sanitary arrangements—I am afraid there was a great want of such an Association as yours at that period.

The condition of man and his environment are graphically described by Professor Dawkins, with which picture of "home life" I conclude—

"The primeval hunter who followed the chase in the lower valley of the Thames, armed with his rude implements of flint, must have found abundance of food, and have had great difficulty in guarding himself against the wild animals. Innumerable horses, large herds of stags, uri, and bison were to be seen in the open country; three kinds of rhinoceros and two kinds of elephants lived in the forest; the hippopotamus haunted the banks of the Thames, as well as the beaver, the water-rat, and otter.

"There were wolves also and foxes, brown bears and grisly bears, wild cats and lions of enormous size; wild boars lived in the thickets, and, as the night came on, the hyænas assembled in packs to hunt down the young, the wounded, and the infirm."

DISCUSSION.

Mr. Vawser: As a representative of a large manufacturing town, I am very glad to come to a small country village, as Mr. Jones has described this place, and to find it very much in advance of many similar places elsewhere. There is not one subject referred to in the paper upon which I should be disposed to disagree with Mr. Jones, and probably his experience differs from ours only because he has been fortunate enough to commence many of his works at a period when the cost of them was very much smaller

than at present; and he has not only completed large works at great expense, but his Board has repaid a large portion of the cost of them. A gentleman of Mr. Jones's experience, who has advised his Board to undertake so many important works, will soon find means to induce his Board to bring up the indebtedness of this town to something like other places in the neighbourhood. We hear of hospitals and baths likely to be commenced very shortly, and doubtless they are necessary. I think it is a delusion on the part of a local authority to suppose, because during a few years the death-rate is reduced to fourteen, twelve, or eleven per thousand, that is likely to be continued in perpetuity; and I agree in the advice given by the Local Government Board, that the Local Board should provide themselves with an isolation hospital, although we all hope it will be long before it is used. I beg to thank Mr. Jones very heartily for his paper, likewise the other gentleman who read the paper on the geology of this district.

Mr. Pritchard: I, like Mr. Vawser, somewhat regret the discussion takes place before the opportunity is given us of seeing the works. I cannot sit down without first of all thanking Mr. Jones for the very able and interesting paper which he has read. There are only two or three points upon which I will venture to raise any question, and he will probably add to the paper the information desired. The great points of precipitation of sewage and disposal of sludge raised by Mr. Jones are important; but, in my opinion, it has not been continued sufficiently far to give the information we desire. As you all know, allusion has been made to the question of the Lower Thames Valley sewage. We have a distinguished visitor to-day, one of the Honorary Members of this Association, our respected friend, Mr. Thornhill Harrison, from the Local Government Board. No one is better able to form an opinion as to the difficulties of precipitation of sewage and disposal of sludge. He has just finished an inquiry extending over fifteen days, after a previous one of forty-five days. In that inquiry considerable evidence was given by chemists, engineers, and others as to the effect of precipitation of sewage and purification of the sewage water to enable the effluent to pass to the river, and the disposal of the sludge. Mr. Jones tells us, that whether sewage is to be taken to land—that is, the sewage effluent—or discharged into the river, he would be content, I understand him to say, with milk of lime. There is no doubt that lime in the form of milk of lime is the very best agent we could have. It forms an insoluble which carries down the organic

matter in the form of sludge. In the evidence given by Dr. Tidy it was held that 50 per cent. of matters in solution were thereby disposed of, but with this remarkable difference—while he suggests quiescence is unnecessary, it has been held that is the essence of its success. The questions I would like to ask Mr. Jones with reference to the milk of lime precipitation, are two—(1) the quantity of lime in grains per gallon, or tons per million gallons treated; and (2) the method of thoroughly incorporating this lime with the sewage which has to be mixed; two, I believe, very important points, which will prove of great assistance to our future guidance. Again comes the question of sludge. There are two ways of dealing with the sludge. It has been held, that by the method of compression by means of air under a considerable pressure—something like seven atmospheres—the sewage sludge may be so disposed of; though containing 90 per cent. of water it shall be reduced to a body which contains 50 per cent. of water, or in other words some eight-ninths of the water has been removed, and that sludge may then be handled without difficulty, the water removed by compression being removed for re-treatment to the tanks. But that has been proved to be a very expensive process, though no doubt a very perfect one, of dealing with it. I do not know any gentlemen better entitled to the credit of being able to solve this question than Messrs. Johnson, of Stratford, in the arrangements they have made in the dealing with sewage by compressed air. Then in dealing with sewage sludge by disposal on land, we have the very considerable and important town of Birmingham, where this system is in operation. Something like 600 cubic yards of sludge per day is thus disposed of. But what is the cost? It is taken upon land to a depth of eighteen inches or thereabouts, once in three years. But the cost of that represents something like, in the year I refer to, the year before last, 13,000*l.*, or representing about 5½*d.* per head of the population for treatment of sludge alone. Now, we are told, precipitation of sewage should cost something between 3*d.* and 21*d.* per head of the population. Mr. Jones has not given us the cost of treatment of the sewage, nor the treatment of the sludge. He has told us, with the heat by means of the destructor in combination with the ashes, he can dispense with fuel for ordinary working plant, for the ordinary steam generation, but he does not tell us what is the gross cost of the treatment of sewage, and what is the cost of the sludge.

Mr. Ellice-Clark: I do not wish to divert the attention of the meeting, but should rather turn to the diagrams and ask Mr. Jones how much per bed is the estimated cost of this hospital, and the object of carrying down the basement storey.

Mr. Jerram: There are one or two points I should very much like to call attention to. Did I understand that before a house is built the street must be flagged, paved, kerbed, and made up in a certain manner? We tried to get a bye-law in our district a couple of years ago for that purpose, and we were informed by the Local Government Board that such a bye-law was illegal and one which they would not approve, although they had approved of a similar one in the next district. As Mr. Harrison is here, I should like to know if the Local Government Board should not act with local authorities by allowing one the same benefit they do others. There has ever been considerable difference of opinion as to the definition of new *street*. What is the practice in Ealing? Some local boards wish to call old lanes when widened new streets, and then to call on the owners of property abutting on such street or road to make up and sewer such road, under the provisions of the 150th Section of the Public Health Act. This is a matter exercising the minds of members of local boards, owing to recent decisions in the Law Courts. Then as regards sewage works. I should like to know the cost per million gallons of disinfectants used? That is an important item in dealing with the sewage. Then we have not had the quantity of sewage Mr. Jones has to deal with per day: whether he has the duplicate system or whether the sewers take the storm water. I have heard the remarks of Mr. Pritchard as to machinery for drying and compressing sludge, and, from my experience, in very few cases did they get a whole cake; I think it is only on the visit of a deputation that you get one, as the cost is so enormous to get the water out.

Mr. Angell: I have one question to put to Mr. Jones—how he gets rid of "jerry" builders? I should like to know how it is that he secures a Board that will suppress the "jerry" builder? In my own district strenuous efforts were made to get their friends on the governing body. It is important that if these men are to displace those who endeavour to carry out the law, there should be some power above which may support us. If the "jerry" builders get the rule of the Board, this Association, or some body, ought to take means to induce the Government to take it out of the hands of the Board, and to make their building surveyor an indepen-

dent officer, so that it does not depend on the local board. If Mr. Jones will tell us how he gets rid of the "jerry" builder, it will be information acceptable to us all.

Mr. LEMON: I hope the day will come when we shall do away with bye-laws and have one general Act. Bye-laws are uncommonly good things, but we find great discrepancies in them. I disagree with my friend Mr. Jones, when he says it is parodoxical with a death-rate of 12 per 1000 to talk of an infectious hospital. I think we should turn our attention to sanitary matters in times of health, to prevent disease. We generally find the contrary course to be taken. I shall make some remarks on the lines of Mr. Pritchard, as to the disposal of sludge. I do not understand why in Ealing Mr. Jones has such a large quantity of sludge. In large manufacturing districts you must have a large amount of this, but in Ealing, a purely residential town, I think it could be considerably decreased. You have plenty of land, and a small quantity of disinfectants would purify the sewage to such a state as to reduce the quantity of sludge. I cannot discuss the paper as I should like, because I have not seen the works. We may have the opportunity of eliciting a little further information when we have done so.

Mr. GODFREY: I do not think we heard throughout the whole of the paper where the water supply was derived from. That is an important point in sanitary matters.

Mr. JONES: It is supplied by the Grand Junction Company.

Mr. J. THORNHILL HARRISON (Local Government Board): I am very happy to meet so many kind friends to-day. There are one or two questions upon which I may make an observation or two. As to bye-laws, I have nothing to do with them. I quite agree with what Mr. Lemon says. The knowledge of what bye-laws are necessary must be very well established, and it would be well to have a general Act. As to the question of dealing with sludge, each place requires separate consideration. There are many towns where the difficulty of getting rid of the ashes and refuse is as great or greater than getting rid of the sludge. In Ealing Mr. Jones is in that happy condition of getting rid of the ashes and sludge as well. It may be he has adopted the best means of dealing with them by destroying both together, and making a useful residuum. But take the case of the Thames Valley Joint Board, the circumstances are exactly the opposite to those of Ealing, each town, each several authority in the United District,

has to deal with its own ashes, the Joint Board has simply to deal with the sludge; in that case it may be the best plan, though expensive, to deal with it by compression. I think that the Joint Board is very possibly adopting the best means of dealing with it, as it is a great point to deal with it so as not to be a nuisance. As to the lanes. I held an inquiry lately as to the claim made by the Local Board of Willesden. Claims were made for private improvements on the owners of property adjoining such a lane. The lane was undoubtedly an old-established bye-lane, used from time immemorial, and repaired by the Board, and the greensward used in summer-time as a footpath. The owners of adjoining property gave certain land for widening the road, and then the Local Board said, You must make a footpath. I think an order is issued that the Local Board has no right to call upon them to do this. In the case of Widnes, where they had a great number of these lanes to deal with, the Local Board took the bull by the horns, and arranged with the adjoining owners to give land, and the Local Board made the roads straight and wide. That appeared to me just and reasonable.

Mr. Gordon: I was glad to hear from Mr. Harrison his remarks upon one of the questions. He is of opinion that we must not take Ealing as a type for dealing with the two refuses. Towns have to deal with the ordinary town refuse and the sludge, and he does not look upon the mode adopted at these sewage works as being possibly applicable to every town. Every town must be dealt with under the peculiar local circumstances of the place. It is more particularly and specially interesting, to see how Mr. Jones has dealt with the sludge. As Members know, I come from a town where we are in considerable difficulty with regard to the sludge. Mr. Pritchard told us how they are dealing with it in Birmingham, but there are very great difficulties in dealing with it in that way. Many towns have not the land to deal with it in that manner. I am very anxious to see whether the circumstances warrant the application of the same principle to Leicester as adopted by Mr. Jones. Mr. Jerram has not formed a very favourable opinion of what he has seen as to drying the sludge. I do not know whether he has seen Coventry or not; I have been there on two separate occasions; I have seen the cakes turned out there and never heard of the difficulty at these particular works. But I am quite sure that process is an exceedingly expensive one. I should like Mr. Jones to tell us if he can, what the quantity of sewage in

Ealing is, if he can tell the quantity of lime used, and also during what hours it is used, and whether it is varied in quantity during the ten hours of the day, or whether during the night, and then if possible the quantity of sludge he has to deal with. Various towns differ in quantity per million gallons. In Birmingham they have over 500 tons a day with 13 million gallons of sewage. At Leicester with 7 to 8 million gallons of sewage greatly diluted with subsoil water, we have 168 tons of sewage daily. As to dealing with sludge by a destructor, it does not appear applicable where it has to be dealt with without the ashes. The process would scarcely, I am afraid, be applicable in Leicester, where there is the difficulty of carrying the ashes to the outlet works. We could not carry the refuse to the works without greatly increasing the cost. Mr. Jones is exceedingly fortunate in having impressed upon his Board in the past to provide for future wants, otherwise he could not have carried out the works so adapted to the present. Ealing will compare favourably with any other town in having reduced the mortality to the extent it has done. I congratulate Mr. Jones upon the works we are to see, and what we have heard this morning.

Mr. Lobley: I shall be glad to hear from Mr. Jones how he deals with the old narrow lanes as they are built upon in his rapidly growing district. It is a curious anomaly in the Public Health Act that a local board can define the lines of street when a building is taken down, but for vacant land they have no similar power except by agreement with the owner, or by obtaining a provisional order. This is a very cumbrous method whenever an old lane is built upon. Generally the land can be acquired by agreement, but it certainly should be in the power of a local board to prescribe the line of building.

The President: I hope gentlemen will not think I wish unnecessarily to curtail this discussion, if I remind them of the time and suggest that any Member who still wishes to take part in it will send his views to the Secretary. I will now call upon Mr. Jones to reply.

Mr. Jones: I think it will be better to take the suggestion made just now, and to add to my paper the details asked. In reply to Mr. Lobley: in such cases we always see the owners and come to terms. As to whether there is any Act of Parliament, the question is not raised. The Board give their unqualified support to their surveyor in carrying out the several matters with which he has to

deal. That is the reason why we have no jerry builders. In everything of the sort I have the most thorough support any surveyor can have in connection with all these matters, and that has been my experience during the twenty years, and consequently the district has grown, and grown well. I quite agree with Mr. Harrison that every tub must stand on its own bottom, but it must be remembered that there are more small districts than large ones. There are not many with 400,000 people, such as Mr. Pritchard refers to, but there are hundreds with populations varying from 5000 to 25,000. The smaller are more difficult to deal with. We use sludge and ashes because it suits our purpose to use them together. I should have as much difficulty in dealing with the sludge as with the house refuse, so I put these together and take them as they come. As to the water supply, we have positively nothing to do with the water companies in connection with our sewers. Respecting the isolation hospital, the plans are what they are, simply because the Local Government Board prefer them so, and we prefer to please them in connection with the matter. We have a separate system, but not a thorough separate system. I would not drain a town now unless I were allowed to carry out a thorough separate system, but twenty years ago sanitary matters were not so advanced as now. In the case of anybody making new roads, wherever I can give an outlet for a separate system I insist upon their putting it down. Referring to a question asked by Mr. Pritchard, I should have added to my requirements in connection with the water when taken into a stream, that the said stream should be "not potable." With reference to a question raised by Mr. Gordon, I do not think the variation of quantities one hour to another is much. It will equalise itself: it has generally done so. I thank you again for the kindly way in which you have listened to my paper, and am much gratified if anything I have said will produce a beneficial effect. Our works are not quite as complete as you would expect. The machinery which would suggest itself is not at present on the works, but will be added before very long.

The PRESIDENT: It has been suggested to me that there are Surveyors present who are not members of our Association. I should like to take this opportunity of impressing upon them the great advantage to them and to us of their belonging to our Association, and sending in their names to our Secretary. With reference to the first paper, read by Mr. Brown, I trust he will not be disappointed with the comparatively little notice taken of it.

It is upon a subject of very great interest to us. There are very few of us who have not some slight elementary knowledge of that subject, but it does not fall to our lot to follow it up in such a way as to be able to discuss such a paper as Mr. Brown has read. But we appreciate it very highly, and thank him very sincerely. We do in our practice get occasional confirmations of the theories which geologists promulgate. I myself, some time since, found part of the tusk of a primæval elephant at Oxford, and no doubt others now present have found similar remains. As to Mr. Jones's paper, we have been greatly interested, and I think I may say it has conveyed a great deal of information. We congratulate him on the very favourable position in which he is placed. Few of us can boast of local boards having a debt of only about one-fourth of the rateable value, but I apprehend from the indications given us to-day, that debt will be increased shortly. Mr. Jones is to be congratulated upon the very capital state of his district. He has rather amusingly spoken of it as a little village. If it is a little village, it is very favourably placed. Many villages cannot compare with it in sanitary matters. I am sure after the prosperity we have heard of, it is at all events certain that it will never be a "deserted village." There is another matter I should like to refer to. It is the first time in my recollection that we have been favoured with the presence of one of the Inspectors of the Local Government Board. He will not, I am sure, think me obtrusive if I thank him in my own name and that of the Association for his presence, and express the hope that this will become a precedent for future occasions. There is one duty we must not omit, and that is to pass a vote of thanks to those who have read papers.

The vote of thanks was carried by acclamation, and the conference terminated, those present adjourning for luncheon, at the close of which the President proposed the health of Mr. Jones and thanked him for the preparations made for the day.

The toast having been enthusiastically honoured, Mr. Jones briefly acknowledged the compliment.

CORRESPONDENCE.

Mr. W. Santo Crimp: I am glad of an opportunity of informing the Members of the Association as to the disposal of sludge at Merton.

It will be remembered that the District meeting of December

5th, 1879, was held at the Merton Sewage Works, then in course of construction, and a short description of the various works for the disposal of the sewage of the district was given by me, then acting as Resident Engineer on the Works.

In the description, it was stated that there were "two filter presses for the consolidatien of the sludge." The works have now been in operation for two years, during which time I have had many opportunities of observing their working.

The sewage from the outfall sewers passes through two tanks, with a chamber across each, 4 feet in width, filled in with coke; this acts as a filter, and a considerable portion of the solid matter is arrested. The tanks are cleaned about twice weekly, the sludge being swept into a large pit. From thence, the sludge flows into a mixing well, where fresh milk of lime is added, the mixture of the sludge with the lime being effected by means of arms fitted to a vertical shaft operated by the pump-engine. When incorporated, the mixture is received into either or both of the large wrought-iron vessels provided for the purpose, on their being exhausted by means of an air-pump; when full of treated sludge, the air-pump is reversed, and the sludge is forced into the presses, where, under the low pressure of about 40 lb. per inch, the moisture is forced out until cakes are formed containing about 50 per cent. moisture. As the sludge contains about 90 per cent., it follows that 8 tons of water are separated from each 10 tons treated. About 6 tons of cake are produced daily, and a contract has recently been made with a landowner in the neighbourhood, he agreeing to keep the works free of sludge and pay 42*l.* per annum for it.

It is difficult to arrive at the cost of thus treating the sludge, the machinery being attended to by the man in charge of the pumping engines, and the men attending to the presses are engaged in other operations as well. The result, however, is highly satisfactory from a sanitary point of view, the whole of the wet sludge and cake on the works, on the occasion of my visit on Monday last, amounting to a few tons only.

When it is remembered that the works were carried out in consequence of an injunction obtained by a riparian owner against the Sanitary Authority of the district, and that the sewage works were established within 150 yards of his mansion, and that these operations have been carried on for two years without evoking a single complaint from him, it is difficult to conceive of any system of sludge disposal more admirably suited to the peculiar circumstances of the case.

After luncheon the Members were conducted over the Ealing Southern Outfall Works, where they had the opportunity of inspecting in full detail the highly interesting sewage and refuse destructor, which was most clearly explained by Mr. Jones. After which a visit was paid to the Outfall Works and Tanks of the Brentford Local Board, where the party was met by the Surveyor, Mr. Lacy, who afforded every information relative to the operation of the system adopted at these works. The Members then proceeded to the Outfall Works and Tanks of the Chiswick Commissioners, which were fully explained in a most satisfactory manner by Mr. Strachan, the Surveyor. Before separating, the Members expressed themselves highly gratified at the great courtesy shown by these several gentlemen in their interesting and lucid explanations, which were universally acknowledged as contributing to an otherwise very instructive and enjoyable meeting, and for which they considered these gentlemen entitled to their warmest thanks.

ANNUAL MEETING IN NEWCASTLE-ON-TYNE,

July 10, 11, and 12, 1884.

ADDRESS OF THE PRESIDENT,

W. G. Laws, M. Inst. C.E., City Engineer, Newcastle-on-Tyne.

Gentlemen,—Permit me to thank you very sincerely for the honour you have done me in electing me to the office of your President for the coming year, and to thank you none the less that the compliment is due more to my being a Member of the Northern District than to any claims of my own. That is as it should be, and I can only express my hope that by your kind assistance and forbearance, I may be able to discharge the duties of the office in such a way as not to discredit your choice.

It is a peculiar pleasure to me that this honour has fallen upon me in the town which is my birth-place, in which so many years of my life have been passed in the practice of my profession, and in the well-being of which my present office gives me a special interest.

The chair of this Association is one that any engineer may be proud to fill, and prouder still, if at the end of his term of office he can look back on it, and feel that the interests and status of the Association have not suffered in his hands. That the task of following the very able men who have already filled the chair is no light one, you all know even better than myself. There is not one of them who cannot point to "something accomplished, something done," which has forwarded the interests or increased the usefulness of the Association. It has grown in their hands, thanks partly to their own energy, and partly to the loyal support you have given to them, and I ask from you a continuance of that support, with-

out which a President can do but little, and which is the very bond and keystone of our Society. United we are strong, disunited I hope we shall never be. There is an honourable and useful future before the Association, and by united and well-directed effort, each and all of us can aid in the securing of that future; everyone of us can feel that he has helped forward in some degree, our common objects, and that he will profit by their attainment.

The Association has now been in existence for eleven years, practically it owes its birth to the Local Government Act of 1872; it was ushered into the world by a few shrewd and far-seeing men, who recognised the necessity that the executive officers appointed under that Act should have an organisation, and that to unite them by the bond of their common professional interests would consolidate their power, and give them a weight and consideration which individually they could not have.

The Association thus formed has been carefully nursed by those who first stood sponsors for it, and by their efforts, and by those of their successors, it has steadily grown in strength and usefulness, and is now a healthy and promising Society, and likely to reach maturity and do credit to their care. But there is much yet to do, and we must not suppose that the time has come for relaxing our efforts or resting on our oars.

On the contrary, this is just the critical time when every effort, individual or joint, will tell most effectively.

We number now, some 230 Members, while there are still about 800 engineers and surveyors eligible for admission into our ranks. We must have the whole of them. So long as there is one engineer or surveyor, holding public office, still outside of the Association, so long will it be incomplete. We want every man to be one of us who can aid our efforts or forward our interests, or to whom it will be of service to be a Member. Every addition to our numbers increases the weight and influence of the Association as a whole, and makes its Membership more valuable. We should welcome among us every man who, from his work and experience, can give us information on the subjects with which we deal, but we *need* every man who is engaged in the practical working and carrying out of the objects of the Public Health Acts.

The Association should be the centre to which all experience and information on municipal and sanitary work should naturally gravitate, and our meetings should be the medium of communication through which ideas can be interchanged, and those floating scraps

of knowledge which collectively form a valuable fund of engineering experience should be fixed and recorded in our Proceedings.

No time can be more opportune than the present for establishing such an institution as ours on a firm and lasting basis. Sanitary reform has never been more active than now, and there is every sign of that activity continuing. The public interest in all matters bearing on the health of towns increases day by day. Sanitary legislation is active, and we, as the executive body on whom it will fall to carry out the laws as they are made, and on whose experience such laws are largely based, should be no less active in gathering together into a concrete form the results of that experience, and in enclosing within our ranks the workers who are making it. There is no man, however small the district on which he works, who has not something to tell us that is worth telling; and there is none, however large the operations on which he may be engaged, who has not something to learn from his fellow-workers in the same profession. We want the whole of them, great and small, and all the knowledge that they can bring to us. There is no need to canvass for recruits. What we have to do is to show them that the advantages we can offer to them are real and substantial, that here they can bring their varied experience, and always exchange it for more than they bring. Let no man think that he has nothing worth saying or writing to such a body as this, that is a fallacious idea that only retards progress. The small detail that seems trifling to him because he knows it, is sure to be new to some one who has not yet learnt it in the same way, and even if he teaches little, he will learn much from hearing the varied views of others, each of whom can throw some modicum of light upon it. If this principle be carried out, of each bringing his contributions to the common stock, there is no reason why our Transactions should not become as valuable as those of the two larger institutions, the Civil and the Mechanical Engineers. Many of you who are present here are members of one or other of these bodies, most of you are familiar with their Transactions, and know practically the great value of those records of individual work and experience.

There is hardly any subject in engineering on which they may not be consulted with advantage; and mark this, the most valuable of those volumes were compiled at the very point in the history of those institutions at which ours now stands, that is when the profession of engineering was being made. Municipal and sanitary engineering is now the branch of the parent profession

in which there is most activity. We are now making its history, and our records should embody that history; let us take care that they are complete, and their value both to ourselves and to those who follow us will be the greater. Most of us have had reason to regret that we did not at the time note down some fact or result at which we had arrived, finding that memory was treacherous, and that useful data were lost of which we should have been glad to have had a record. Well! note them down! but do not stop there, bring them to the common stock, and let them be recorded in our Transactions, so that they may be accessible not only to ourselves but to others hereafter.

Let me repeat it once more, for it is important. We have our opportunity before us, and there is not one of us who may not assist in making the history of sanitary engineering, and feel that in so doing he is helping to consolidate the power, and increase the influence of an Association which has a great future before it.

It is a matter worthy of the consideration of the Council of the Association whether they should not follow the example of the larger institution, and issue more frequently than they do the lists of subjects on which papers and contributions would be welcome. This would serve to keep the questions and problems of the day before the minds of the Members, and no doubt elicit many useful and valuable contributions to our Transactions.

The sanitary problems of the day are many and various, and most of them are of great moment to thousands of our fellow-creatures. Some of them have been problems since history began, and are still waiting solution. Such is the "Removal of Refuse," which taxed the skill of Moses the Lawgiver of the Israelites, when he had to provide for the sanitary condition of the camps in the desert.* His method was simple, but it recognised the principle which rules the question still, viz: to get the refuse quickly out from among us. We have grafted upon the question several minor ones, such as "Sewage Farming," and "Utilisation of Refuse," but the main question which we still have to consider, and for which we still strive, is, how best and most quickly to remove the refuse beyond our boundaries.

There is also the important matter of procuring pure and wholesome water for domestic use. That has been solved successfully for many towns, and the highest engineering skill has been applied to it; but it has not been got rid of, and as populations

* Deut. xxiii. 12–14.

increase and thicken round our great centres, as the value of cleanliness of person and dwelling as vital conditions of health are more widely known, the supplies that were ample twenty years ago become insufficient now, and the problem has to be solved again.

Healthy dwellings for ourselves, in which hygienic laws shall not be set at defiance, is a subject upon which science, experience, and skill are ever at work, and in which individual needs will always be supplied by individual effort. Healthy dwellings for our artizans and labouring classes is a much more pressing question, which is taxing and will tax the utmost effort both of local and imperial legislation.

It is a question which civilisation has begotten and which civilisation itself has rendered more and more difficult.

Civilisation has crowded man into limited spaces by enabling him to have his food supplies brought to him on the spot where he finds the readiest market for his labour. But for the modern facilities for transport given by improved roads, by steamships, and by railways, such towns as London, Glasgow, Liverpool, and many others could not exist for a month. No one who witnessed the effect of the great snow-storm of 1880–81 in London, could help speculating on the critical nature of its position, had the block to transport continued even for a fortnight instead of a few days.

A population of 4,000,000 means a daily consumption of 5000 tons of food stuffs, and the daily removal of 70,000 tons of liquid and solid refuse through the sewers.

A month's stoppage of the supplies would mean starvation to thousands, a week's stoppage of the sewers would mean disease and death to thousands also. So that civilisation, while it has enabled men to live together in much greater numbers, has also rendered their position infinitely more critical, and necessitated special provisions for their comfort and safety as a community.

And it has also led to the great problem of how to house the labouring classes. Space in the centre of London has become so valuable for manufacturing and business purposes, that it is too dear to live upon, and the living links in the great machine, the flesh and blood, without which manufactures and business must cease altogether, are driven to herd together in slums that are unfit for human beings to exist in, or they must migrate beyond that wide belt of middle-class dwellings which forms greater London and add to their daily toil a weary journey morning and night. This is a

problem the solution of which calls both for wisdom in deliberation and skill in administration.

In all these problems, gentlemen, we Municipal and Sanitary engineers are called upon by our position as advisers and executive officers to take no small part. Every one of us has some share in one or more of them, and is, or may be called on to-morrow, if not to-day, to task his brains to advise upon, and his energies to carry out, some part of them. And this it is that makes the value of such an Association as ours, and of such meetings as this, where we can discuss the sanitary problems of the day and compare and exchange our experiences. Sanitary progress is aided by our discussions, methods that have been successful are explained and made generally known; and what is equally important, failures are published, their causes investigated, and similar mistakes guarded against in other places.

And now, gentlemen, I will not longer detain you from more interesting business. We have much to do, and many things to see, for we northern men wish to show you a few of the characteristic features of our town and river, that you may have a glimpse of those industries that are rapidly making Tyne-side into one continuous town 10 miles in length, and creating for us some of those practical social problems which have made our profession and give employment to its Members.

THE INSPECTING AND TESTING OF THE SANITARY ARRANGEMENTS OF HOUSES.

By J. P. SPENCER, A.M.I.C.E., F.G.S., of Newcastle-on-Tyne.

In proposing to read before you a short paper on the inspection and testing of the sanitary arrangements of houses, I am wishful to draw your attention to a subject which is now very prominently under public notice, and to raise, if possible, a useful discussion among a body of gentlemen best qualified to consider a matter which intimately relates to one of their daily duties.

Doubts have been expressed as to whether it is possible for the officers of a sanitary authority to find sufficient time to properly inspect and test the sanitary appliances of all the houses in its district.

Judging by the staff and assistance usually accorded to such officers, I think we may come to the conclusion that such doubts are fully justified. It has been found from actual experience:—

(1) That the drains and sanitary appliances of all houses should be examined and tested not less than once a year;

(2) That one inspector, giving his whole time to the duty, cannot inspect and test more than an average of 400 houses per annum.

It seems, therefore, improbable that any sanitary authority would keep a sufficiently large staff of inspectors to test every house once a year, even if they had the power to make it compulsory. This average, however, would, in practice, be very much reduced from various causes, such as the establishment of the Sanitary Inspection Associations, which are daily gaining favour and influence, and also by the attention given to this subject by owners of the better class of houses, who prefer to have their houses (especially when they occupy them) dealt with by private engineers. These and similar causes take a number of the larger and more complicated cases out of the category, and leave to the public inspectors chiefly those houses whose owners are unwilling, or whose occupiers are unable to pay for the inspection and test.

It must be regretted that the sanitary laws empowering compulsory inspection and control of drainage and other sanitary arrangements fall so far short of what is required to make them practically useful; on the other hand, to have a private house invaded by the corporation officers, without notice, would be well-nigh intolerable, but after all the notices and times of probation enjoined by the Acts have expired, and the officer becomes entitled to inspect the premises, the powers and facilities allowed him by law appear to be too restricted to result in thorough investigation, much less remedy.

The law, however, does reach all that comes under the head of "Drainage," and the most efficient way of testing the drainage is a subject probably well known to all of us, but still I trust worthy of our present attention and discussion.

Further than this, there must be hundreds of householders who are not only willing but anxious to have the sanitary arrangements inspected and tested by the corporation officer in preference to any private source, and I assume that it must be the desire, as well as the duty, of every Member of this Association, holding an appointment under a sanitary authority, to be able to respond to such a call in a way equally thorough and efficient with that of any officer of a sanitary protection association, or a private engineer.

I am quite conscious, to many here to-day I am able to communicate nothing new; but I venture to occupy your attention hoping to promote such a discussion as will develop and accentuate the knowledge we already have.

The first step seems naturally to be to ascertain whether the drainage from the house is actually running freely from the premises, and in its proper channels, into the main sewer.

Where the entrance to the main sewer is by means of a disconnecting or inspection shaft this can be easily ascertained, but where the house drain is actually connected into the sewer there is nothing for it but to dig down and expose it to view.

In the latter case, when the ground is open, it is easy to construct an inspection shaft or manhole which shall not only enable future inspection to be made readily and without expense, but will isolate the drainage from the common sewer and each house from its neighbour. I take it that this is a primary step in preventing the spread of infection by means of the drains. The manhole or disconnecting shaft should be ventilated, and should be trapped against the sewer, and the connection of the house drain

into the shaft left open so that a current of fresh air may pass up the drain pipe.

Between the manhole or common sewer and the house there is generally a long length of drain. In many cases, where the town sewer is situated in a back street, no part, or only a very short part of this drain is situated actually under the house. Under any circumstances, it is important that this part of the drainage should be tested, even if only to prevent leakage into the ground and foundations; but where it is situated under the house it becomes specially and essentially important to do so.

Where there are no back streets, and the sewers are situated in the front, the house drains are frequently brought from back to front under the basement floor.

These pipes are sometimes of stoneware and sometimes of metal, but where they pass under any building they should always be metal, with strong spigot and fawcett and lead joints. At various intervals along the length of these pipes, openings and traps will generally be found for the entry of branch pipes, and they are always, except in the case of badly designed drains, kept clear of the house.

It is evident that a very clumsy and inconvenient method of testing such a drain as this would be to open it all up, pull up the pavement and floors, and inspect every joint. A simple expedient is to test it by filling it with water.

Select some inlet where you would have a pressure from a head of water of from 2 to 6 feet; plug up all the openings whose outlets are below that level, and also plug up the connection into the manhole or other outlet from the house drain to the main sewer. The whole system of underground pipes can then be filled with water up to a certain level, care being taken that the outlet at the manhole is perfectly stopped with pugged clay or other means; if the water remains up to the original level, and does not sink or disappear, it is a proof there is no leakage from the pipes. The pipes should be filled under the eye of the inspector, so that no tricks may be played; for instance, in the case of new houses where the drains have just been covered in, the inspector should know approximately what quantity of water is required, and should not be content to find the pipes already filled for him, or he might discover, perhaps, that a false plug had been put in the first length of pipe and the water prevented from passing beyond the first joint. By seeing the removal of the plug at the manhole, such a

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trick as this might be detected, as the quantity of water used would then show itself if the gradient be known, but a better way is to calculate the cubic contents of the given length of drain pipes and measure the number of gallons put in. For instance a drain 4 inches diameter would require ·54, or a little over half a gallon for every lineal foot; and a drain 6 inches diameter would require 1·22 gallon, or nearly a gallon and a quarter for every foot in length.

The next points to be ascertained are the positions of every sink, bath, lavatory, and waste and overflow pipe in the house. With regard to the sinks, it is frequently found that they each consist of a mere pot trap, which admits of a large quantity of sediment remaining in the trap to become a nuisance and a danger to health. A much better and more simple form is the ordinary syphon or "S" trap, which may properly be styled the "wash-out" trap, and certainly one more likely to enable all foul and objectionable matter to be carried away from the house at once instead of being retained, as in the other case. I would, therefore, recommend this kind of trap for all sinks, both indoors and outside, which are meant for the conveyance of liquid refuse. Of course in the case of garden paths the box gully may be used to prevent the passage of gravel, &c., into the sewers.

I need scarcely enlarge upon the absolute necessity of having every waste pipe and overflow entirely cut off from connection with any drain. This is a condition now generally recognised and insisted upon by all of us. It is only necessary, therefore, for the inspector to trace every one of these and be certain that each is made to deliver upon, or nearly upon the open grate of a syphon-trap gully outside the house.

After tracing and inspecting the waste and overflow pipes from the baths, lavatories, housemaid's sinks, kitchen and scullery sinks, and other prominent pipes, search should be at once instituted for all those concealed dangers which probably some one has been at great pains and ingenuity to perpetrate. They will consist chiefly of the overflow pipes from the water cisterns, the waste pipes from the leads above the portico and bay windows, the overflow from the conservatory, the overflow from the small ball-tap cistern to the kitchen boiler, and the waste pipe from the lead safe under the basin of water-closet.

Two of these, viz. the pipes from the cistern and from the lead safe, used to be very often introduced direct into the soil pipe.

The positions are so near, and the convenience so great, that the temptation could not always be resisted; besides, it gave another opportunity of wiping a lead joint, a thing dear to the soul of plumbers.

The positions of the heads of all the rain-water pipes should be carefully searched out and noted, and if any be near windows or other openings into the house, or under verandahs or galleries, they should be completely disconnected from the drain and made to deliver upon the open grates of syphon gullies.

The soil pipe is a part of the sanitary arrangement claiming especial attention. The size is generally 4 inches in diameter, and where possible it is best to keep it outside of the buildings. The only objection to placing the soil pipe outside is where it is found necessary to have a trap at the foot of it, or where the constructor of the house has made such a trap, whether necessary or not. If this trap be not placed sufficiently deep in the ground, there is a danger, in severe winters, of the water in the trap being frozen, and then, of course, the whole working of the apparatus is stopped. To avoid this it is best to so construct the drainage system as to obviate the necessity of the trap, but, if found absolutely necessary, it should be placed at such a depth as to protect it from frost.

The ventilating pipe from the soil pipe should be carried up above the roof the full diameter of the soil pipe, and it should be clearly ascertained that the terminal of the ventilating pipe is not in such a position as to enable the air from it to be blown through windows or other openings into the house.

The question of what kind of terminal to place on the ventilating pipe is one about which a difference of opinion exists. Some advocate the fixing of special kinds of "air-pump" or other patent ventilators; others prefer the end being left simply open or with a mere coned raised cover. Unless special circumstances suggest the use of a special form of terminal, it is, as a rule, best not to put anyone to this expense, and the advantage over the open end has yet to be proved. It is as well, however, to protect the opening by means of coarse wire netting, because the house sparrow is not discriminating as to where he builds his nest.

The position and connections of the water cisterns are of great importance. Certainly the supply to the water-closets should be by means of a separate cistern, and this should be insisted upon.

It is best where possible to have all taps from which water can be drawn fitted upon the rising surface pipe, so that no water for

drinking or cooking purposes shall ever enter the cistern at all; but where this cannot be done, the cistern should be periodically examined and the sediment completely removed and washed out. It is quite usual to find cisterns concealed away in the roof, and with dead flies, moths, and dusty scum floating on the water, and I have myself met with cases where dead mice have been found in the cistern used for drinking-water purposes.

It should also be seen that the overflow pipes are all carried to the outside and made to discharge upon the roof or otherwise into the open air.

Having thus briefly reviewed the course recommended in inspecting the sanitary and drainage arrangements of a house, I will, as briefly, again refer to the testing of them.

The best engineering skill and design may be nullified through defective materials and workmanship. In all these works the whole system is only as efficient as its weakest part, and it becomes important to find out hidden defects, if any exist.

I have already dealt with one test for drain pipes at a low level. This, however, would not be suitable for the pipes and appliances within the house, and ranging from the basement to the roof.

A ready means is by the "paraffine" or the "peppermint" test. As a preliminary test, when suddenly called in, and when other means are not at hand, an assistant may be sent upon the roof to pour paraffine down the soil-pipe ventilator; or if there be no such ventilator, then down some distant sink.

To use the oil of peppermint in a similar way it should be poured into two or three gallons of hot water, as nearly boiling as possible, and then sent down the pipes.

As it should never previously be introduced into the house, if it is not possible to find, or to make, an opportunity of applying it from the outside, the operator (who should not be the inspector) should shut himself in the room where the sink is, and stuff up the crevices of the door. He should then pull up the bottle containing the oil of peppermint through the window by a string pour it first and the hot water after, down the sink, and remain where he is. In the meantime the inspector ranges the house, the doors and windows of which have been closed, and if there is any leakage into the house he soon detects, and should proceed to localise, it.

A better test still is the "smoke" test, which is applied by a small fan blast worked by hand.

The first process should be to apply it outside, or in the areas, to such open gratings as are situated between the traps and the house, and assuming that the desired aim of the sanitary arrangements is to always have a current of fresh air blowing up the drain pipes and out of the ventilators, the smoke should follow the same course and be sucked in at the grating and eventually come out at the tops of the ventilating pipes.

The place of ingress of the smoke may then be covered all round with mats, or with clay, &c., and the places of egress at the tops of the ventilating pipes stuffed up. The smoke being then forced in, the application will be under pressure. If any of the smoke finds its way into the house, it is a sign that there is a defect somewhere, and it can generally be readily traced by following the stream of smoke coming from it. It will be obvious that these tests must be extremely useful in finding out "dry traps," and detecting those extraordinary connections of pipes sometimes leading the sewer gas in a concealed and disguised manner, right into bedrooms, dressing-rooms, and bath-rooms. In my own experience I have discovered actual cases where a pipe has been led direct from the drain into all these rooms, as well as into many other places, bad enough, but not so outrageously careless as into a bedroom. I have in my mind now two cases, in first-class houses, where I discovered pipes, connected directly into the drain, communicate directly into one of the bedrooms.

The exterior traps can then be tested by applying the smoke, under pressure, at the manhole or nearest disconnecting shaft, and by endeavouring to force it through the traps.

The inspecting engineer may now be said to have finished the first stage of his labours, and I only trust that while endeavouring to carry you over the ground with him, I have not finished your patience also.

In conclusion I venture to submit that the objects should be:—

(1.) To isolate the drainage system of each house from its neighbour and from the main sewer;

(2.) To construct or alter the drainage of each house, so that wherever possible a current of fresh air shall pass up and through the pipes;

(3.) To have all houses, old or comparatively new, inspected and tested at least once a year;

(4.) In the cases of new houses, to see that the first two

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objects are attained and carried out during the construction of the buildings, and as forming part of their original construction;

(5.) In the cases of old houses, toh ave the first three objects carried out with as little expense and inconvenience to the owner and occupier as possible, and

(6.) In all cases to have the inspections made by a disinterested person of education, intelligence, and special skill—in other words "an expert," and one who is capable of advising as to the best means of remedying the defects found to exist and of preventing those likely to arise.

DISCUSSION.

Mr. JERRAM: This paper seems to me more a matter for sanitary inspectors than for surveyors. It is the duty of the surveyor to see that drains in new houses are laid and constructed in accordance with the latest sanitary requirements; and the sanitary inspector's duty afterwards to test them for defects. The paper, however, is a very useful and practical one. There are some points in it which invite discussion. Mr. Spencer recommends that all pipes laid under houses should be of metal, from which it is to be inferred that only metal pipes could be made gas proof. Now under the model bye-laws of the Local Government Board—and we are nearly all working under these model bye-laws—where pipes have to be laid under houses, which unfortunately must be the case in the south of England, the pipes are to be covered with 6 inches of cement concrete. If the pipes are laid across the narrowest part of the house, and in a straight line, and then covered with concrete, it is impossible for sewer gas to get through the joints. It seems to me one of the most important things surveyors of new buildings have to do, is to themselves inspect these drains, and not to leave it to a foreman at 25*s.* or 30*s.* a week to see that the drains, where they must be put in under houses, are made gas- and water-tight. With respect to a syphon in front, we know that under the new bye-laws it is necessary that there should be a syphon where drains go through a house, with a fresh air inlet on the house side of the syphon. I know, in my experience, that these syphons frequently become stopped, and then it is not the surveyor or sanitary inspector who is sent for, but the nearest navvy that can be found. As a rule, the syphon is taken up and condemned as the cause of the nuisance, and then you have a magnificent current of sewer gas

flowing into the house—in fact the very thing happening that you wish to prevent. Although a house may be constructed all right when it is built, there is no note kept of any alterations made afterwards. There it is I think that the mission of the sanitary inspector comes in, and I cordially agree with Mr. Spencer that there should be a sanitary inspection made of every house once a year. I also think that a record should be kept of every such inspection in the archives of the local authority, and that it should not be necessary to go to a sanitary inspection company to ascertain the condition of any premises; but that on payment of a fee, the last report of the sanitary condition of a house might be inspected at the office of the local authority. This I believe would be a great boon to the country, and we shall never have a proper sanitary state of things until something of the kind is adopted. First of all the house should be completed, when erected, in a sanitary condition, and afterwards there should be an annual inspection to see that it is preserved in that state. I take this to be the interpretation of one of the clauses of the Public Health Act. This brings me to the number of inspections a person can make. I think 400 a year too small a number for one inspector; it is very little over one a day. From what I know, by my own experience, a sanitary inspector ought to inspect 1200 or 1000 houses in a year, and they could do the work thoroughly and satisfactorily. There are matters dealt with in this paper which are certainly of the very greatest importance. The position and condition of the water cistern is a most important matter. I recently examined the cistern at the town hall where I live, and there found a most magnificent collection of worms, because the cistern had never been cleaned out. It seems to me that we want additional powers with respect to the drainage of old houses. When a house is drained into a sewer, even if it is an imperfect sewer, we have not sufficient power to alter it. We have no power to go to old houses and say "the drainage must be altered," or to compel new drainage to be provided. This is a mattter we may well discuss, and we should seek to obtain powers to bring old houses under the same sanitary arrrangements as new ones. I am of opinion that the other matters dealt with in Mr. Spencer's paper are of very great importance.

Mr. Newman: The paper which has just been read brings to the surface a question to which I have given some attention, and last year I designed a trap to facilitate the inspection of house

drains. I have one of these traps downstairs, which I shall be pleased to explain to any gentleman present. In Mr. Spencer's paper it is suggested that a manhole should be provided at each house. I think it would be found a heavy cost to compel a manhole to be provided at every house. In the case of a small house the simple syphon, with an air inlet commonly in use would be sufficient for the purpose. But, in order to utilise that syphon for the purpose of testing the drainage I suggest that the vertical part should be enlarged conically to form the seating of a disc, which should be made to retain the water inside at any given height. The height of the water being observed, it can be ascertained whether the joints are leaking or not. The reason I designed this trap was to ascertain immediately after construction whether the joints were sound in a house-drain. There is one evil due to leakage from pipe joints not alluded to in the paper, and that is, that the ground is not only saturated but the solids are removed irregularly, and are consequently deposited until a larger flush of water than ordinary occurs, when they are brought into the sewer in a putrescent state. This often causes the nuisance complained of from open sewer ventilators.

Mr. Gordon: I am sure this is one of the papers which it is our province to discuss carefully. Mr. Jerram has touched upon one or two points which are also, I think, equally important. He has told you that it is more a paper for a sanitary inspector—that the duty of the surveyor of a town is to see that the new drains of new houses are laid down in accordance with the received notions of the present time, and then it is the duty of the sanitary inspector to test them and see that they are in accordance with those requirements. We all know the duties of a surveyor are highly important, but I am quite sure it is perfectly impossible to carry out the rule which Mr. Jerram has laid down—that the surveyor should personally see every new drain, and be perfectly satisfied in his own mind that it has been laid strictly in accordance with the regulations in force in his own borough. That would be impracticable in large towns, as many of you know very well. Take, for example, the town in which we are now assembled. It is quite clear that the borough engineer of this city cannot possibly be expected to see to every drain put into new houses, but that the duty must be left in a great measure to inspectors under him. I take it that it is the duty of such towns to appoint properly-qualified inspectors to see that these duties are performed under the directions of the town

engineer. It appears to me that the paper read by Mr. Spencer is intended to promulgate the views of its author, and to invite discussion whether the rules which he has laid down for testing drains, and ascertaining the sanitary condition of old houses are those which would be generally received by this Association. In many large towns there are sanitary inspectors under the surveyor, and it becomes a part of the surveyor's duty to overhaul the doings of these sanitary inspectors, who are under his guidance and instruction. It is also the duty of the surveyor, on many occasions to actually personally inspect the condition of old houses, erected, it may be, twenty, thirty, or forty years ago. It will be admitted that the principle of disconnecting all drains from the main sewer is right, and that the house-drains should be ventilated so as to get a current of fresh air from front to back, or *vice versâ*, without any immediate air connection with any other house-drain. Now, in the course of his duties, a surveyor will be called upon to inspect old houses, erected under conditions very different to those which now generally prevail, and he will in such cases most probably find the house in direct communication with the sewer. It may have several such direct communications, in the scullery, kitchen, cellar and water-closets. You may have had complaints which have caused you to visit the house. You may even have been informed, as sanitary inspector or surveyor, that there is illness in the house, and that the doctor strongly suspects that sewer gas is the cause of it. It has been said that when doctors cannot find out the disease they have to deal with, the next thing to be done is to suspect sewer gas. Well you go to the house and find the occupier could not actually complain of smells and nuisances, but you are satisfied that the sanitary conditions of the house are unsatisfactory, and not such as should be allowed to continue. If you wish to go before the magistrates in such a case, you must be fortified by the opinion of the medical officer of health, and unless some complaint is made by the inmates, or he has strong views himself on the subject, he will hesitate to pronounce it a nuisance, and unless it is condemned as a nuisance you will be unable to enforce any remedial measures. Therefore it is in such cases that you have to resort to the tests which have been suggested by Mr. Spencer. The oil of peppermint and paraffine I have found to be exceedingly penetrating, but probably the best of all is the smoke test. But every one of these may fail you in a case of this kind, and then what are you to do? You know perfectly well that the house is connected direct with the

sewers; but you are perfectly powerless to go before any magistrate to obtain an order to improve the sanitary condition of that house. I think Mr. Jerram is right when he says there requires some alteration of the law to enable you to insist upon the improvement of the sanitary condition of such a house This is one of the things proposed to be embodied in the memorial to the Local Government Board, suggesting improvements in the Public Health Act. The tests named by Mr. Spencer are exceedingly valuable. You can convince people, who otherwise would not be convinced, if you can send smoke through the drains into their kitchens and bedrooms. We may not approve of all of the conditions Mr. Spencer has laid down in his paper. He has told us he thinks there should be a manhole to every house. No doubt it would be very valuable, but it would be exceedingly expensive, and I am afraid you would not be able to carry such a provision out in the case of every house-drain. He has also suggested that pipes under houses, where there is no back street for drainage, should be of metal. I understood Mr. Jerram to say that this is unnecessary, and that pipes may be made perfectly sound by covering them with six or seven inches of concrete. I must say I should have much greater faith in the use of strong cast-iron pipes, coated with Dr. Angus Smith's patent varnish inside and outside, which you might put under a pressure of 20 or 30 feet if necessary. I certainly always recommend that course to be adopted wherever the drains cannot be otherwise laid than through and under the houses. Mr. Spencer has also recommended that syphons should be used for the sinks in the interior of houses. I think there may be some difference of opinion on that head, because if you use, for instance, a 2½-inch syphon to every sink, you will find the people themselves complain of the syphon as a nuisance. Whilst therefore I am strongly in favour of syphons, I am for the reason given somewhat doubtful as to the advisability of their universal application. There are other means of shutting off all connection with the outer air, such as by a small flap valve on the end of the sink pipe. I am inclined to think that is the better plan in a large number of cases. Mr. Spencer has also dealt with another matter which I am afraid has not received the attention it should have done from sanitary inspectors—the question of water supply. The cisterns which supply houses with water for domestic purposes should, in my opinion, have no connection with the supply pipes or cisterns of the closets; and the overflow from such cisterns, we are all agreed

I think, should go outside. As to a disconnecting syphon for every house-drain there may be difference of opinion. It is laid down in the model bye-laws that such a syphon should be applied, but Mr. Jerram has told you, and I am sure it is the unfortunate experience of a good many of us, that these syphons get stopped up sometimes. Then, instead of application being made to the surveyor, or chief sanitary inspector of the local authority, a builder is often called in; if he should happen to be one of those who is probably not particularly friendly to the new regulations, he is very glad to find the syphon stopped, and accordingly orders it to be taken out. There is something to be said in favour of his view, because I believe the general and universal application of these syphons cannot be adhered to without expensive precautions against their stoppage in many cases. It depends very materially what fall there is on the house side of the syphon whether it will be self-cleansing or not. If you can place such a syphon as this at the foot of the soil-pipe, it will never stop up; but if there is a long length of pipe with only a fall of 1 in 50 or 1 in 60 behind it, the chances are that it will stop up in a very short time, unless you go to the further expense and arrangement of an automatic flushing tank at the end of your drain. If a syphon is laid at a gradient of 1 in 20, my experience is (and I have fixed syphons specially with the object of testing them), it will keep itself clear. I think we are very much obliged to Mr. Spencer for his paper, and personally I am glad that the interchange of ideas to which it has given rise will be recorded in our 'Proceedings.'

Mr. McKie: I have given this matter some consideration, but there are only one or two points that I shall mention. My experience has been that it is almost impossible to make a sanitary burnt clay pipe water-tight. The other day, when making some experiments, I found the water did not come through the joints but through the pipe itself. My practice has been to use turned and bored iron pipes, filleted, in addition, with cement. Then you don't want any bothering concrete, which a jerry builder may make of anything he likes, cover it over on the top with good concrete, and deceive you. Then as to disconnecting traps; they may be a great nuisance when the drain is not properly ventilated on both sides of the trap, laid without sufficient fall, and not regularly and effectually flushed. Every house-drain should be perfectly self-cleansing, and for this purpose it should have a self-acting flushing chamber at the dead end of each branch drain;

then it would not matter whether the fall was 1 in 20 or 1 in 60; such flushing, if properly attended to, would clear the disconnected trap. I fixed such self-acting automatic flushing chambers three or four years ago, and they have acted perfectly, and there is not the slightest sign of deposit in trap or drains. If the house-drains are kept well cleansed there will be no difficulty, but sufficient water is not used, and not used in the right way. I do not see why a self-acting flushing chamber should not be connected with the water from a lavatory or bath, and, where water was paid for by meter, it would be a saving of expense, and would almost alone be sufficient to cleanse the house-drains. The paper is a very proper one for us to discuss, and we are much indebted to Mr. Spencer for it.

Mr. Hall (Stockton): The paper by Mr. Spencer I think is everything we could desire, and is a very useful and valuable one. In that I am sure we heartily agree, and I am much surprised that Mr. Jerram and Mr. Gordon* have thought it outside the province of our Association, and more suited for the consideration of inspectors of nuisances. I am entirely adverse to this view, and I consider it is one of the most important functions of a sanitary engineer to look after the matters mentioned in Mr. Spencer's paper. It is, I consider, a ridiculous theory to put forward that borough surveyors have nothing to do with old drains. I consider this one of the most important of a surveyor's duties, especially in old towns. Stockton is a very old town, dating back to King John, and some of the old sewers are in a very antiquated condition, and require a great deal more attention from me than the new sewers do. The new sewers are put down under the supervision of myself and my assistants; but three or four men have to be kept constantly at work improving the old sewers in the town. The Corporation does not expect this important duty to devolve upon the sanitary inspector; far from it, and I consider the surveyor is the proper person to undertake all work connected with the main sewage of a town. I consider that private sanitary inspection companies will be very useful institutions. It will not render the duties of the permanent staff of a corporation or local board any less, but will materially assist them in more thoroughly performing their duties. Before any action can be taken by any of those associations they must receive the co-operation of the public

* See explanation, p. 255.

official, or departments who alone have power to compel a nuisance to be abated. I suppose that these associations are actuated with the laudable desire of trying to improve the public health, and will communicate with the local sanitary authority, and render all the assistance they can, to compel people to comply with the orders of such authority.

Mr. PLATT: There is just one remark I wish to make, which occurred to me after Mr. Jerram had described how that a syphon which had been properly put in was frequently removed by the builder, called in when it became stopped up. This rather points to the necessity of something being done by the Legislature towards compelling people who interfere with drains in any way, to give notice to the local authority, in order that an inspection may be made. This has been done under the local bye-laws at Rochdale, where no one is allowed to touch a drain except on giving notice to the Corporation. This is done by having a list of authorised contractors, the same as authorised plumbers in connection with the waterworks. Each contractor has first to give notice at the surveyor's office that he is about to begin work, and then it is seen to by the Corporation officers. This insures the work being properly done, and that the people who have to pay for it get good work. Besides, if any difference arises between the contractor and the owner with respect to the cost of work, the surveyor is the arbitrator between the parties and decides what shall be paid. I think this is a point which might well be embodied in the memorial to be presented to the Local Government Board—the necessity for notice to be given to the local authority before drains are interfered with in any way.

Mr. A. W. PARRY: I am rather surprised to hear it said that it is the duty of the sanitary inspector to devise and direct structural works. The duty of the inspector of nuisances, or as he is also called the sanitary inspector, is to visit all the properties in the town, more especially old premises; and to report to the sanitary committee any nuisance he finds arising from defects in sanitary appliances, drains, or any other cause. My experience in Reading is, that when any nuisance is reported by the inspector, which in the opinion of the medical officer of health is injurious to health, I, as borough surveyor, am instructed to examine the property and prepare and present a detailed specification of the works required to be done to remedy all defects. Then follows an order from the Council that the works recommended by the

surveyor be carried out. This is entirely the borough surveyor's business.

Mr. Jones (Ealing) : I did not intend to make any remark on this paper, but when the statement has gone out publicly that the engineer or professional man who guides his municipal or sanitary authority in these matters is to transfer his duties to a skilled but subordinate officer, the inspector of nuisances, I think we should certainly raise our voice, however much we may deprecate long discussions, against this being regarded in any degree as the feeling of the Association to which we belong. It is the duty of the engineer or surveyor of a public body such as we represent, to have the entire and absolute control of these various matters, and I regard it as very unwise to think for one moment that the responsibility connected with these duties can be delegated to an inspector of nuisances, although he may be the proud proprietor of the pretty bit of paper acquired by answering the half-dozen questions of the Sanitary Institution, and although he may be a member of the association of which our good friend Mr. Jerram is chairman. Some of the most essential work committed to the engineer of a municipal authority, or the surveyor of a local board, is in connection with these very matters, which Mr. Jerram tells us should be the peculiar department of the inspector of nuisances, a man who is paid, according to Mr. Jerram, 25*s.* a week.

Mr. Jerram: No, not inspector of nuisances; I said foreman.

Mr. Jones: Well, sir, I do not care what you call him! "A rose by any other name would smell as sweet"; and the inspector of nuisances, the foreman, or whatever else you like to call him, would still be just the same. His knowledge and his status would be no more. I would much rather put the work into the hands of a pupil of two or three years' standing, who earnestly and anxiously desired to master his profession, than put it into the hands of a foreman or inspector of nuisances. I do not care what position an engineer or surveyor may hold in connection with a municipal or sanitary authority, it is an essential part of his duty that he should have the absolute control of this matter.

The President: There are one or two words which I should like to say, more particularly with reference to some remarks which fell from Mr. McKie, on cast-iron pipes being used in the place of clay pipes. I must say I have had a prejudice in favour of clay pipes for sewage for some years; but there are some circumstances in which cast-iron pipes have a decided advantage. In

taking up defective drainage I almost invariably find the breaks on the pipe arise from imperfect bedding. You cannot get an ordinary labourer to scoop a hole for the flange of a clay pipe; and wherever a pipe is laid on the flange only, it will break. For some time I have adopted, as an expedient to get rid of the annoyance of clay pipes breaking, to fill in round them and half way to the top with concrete. There is then a firm bed accurately fitting the pipe and less liability to break, and you can see the whole of the top of the pipes uncovered, and that the joints are correct. This answers very well, and we are adopting it not only in house junctions but in main sewers, and the additional security to the drain is well worth the additional expense. Mr. McKie also mentioned a self acting flushing-chamber. I think that it is a very capital idea for keeping house-drains clean. I am afraid, however, that it would cause the consumption of water to increase very much, and to considerably exceed the usual 40 gallons per person. However, that is altogether a secondary consideration. Mr. McKie suggests that the water from lavatories and baths should be poured into the drains by a self-acting flush. That I think is a very good idea, and one that might be carried out. The amount of water passed away from every house is amply sufficient to flush its drains if it could all be put in at once; but in the majority of cases the water from baths or lavatories only just dribbles away. But if you could run bath and slop-water into a self-acting flush, which would go off when full, you would get material carried away which the ordinary flow from a house never will carry off. With regard to the putting in of the drains, I think I have expressed my opinion more than once before, that it is a pity that they are not laid by the local authority. It is very difficult to draw the line where the public authority should step in and the liberty of the private individual stop. I am quite sure, however, that it is an advantage for the local authority to put in the drains in streets which will be under their control afterwards. Wherever a street has to be opened to put in a drain, the work ought to be done by, or under the control of the local authority, who should alone be responsible for the work. I do not think that this would involve extra cost to the corporation or local authority, though that is a matter of secondary consideration in comparison to having good junctions and well-laid drains. Whether we could carry the same principle out with the yards of houses, I do not know. We might go as far as the yard wall, but beyond that I

should not be prepared to go. It would interfere too much with the liberty of the subject if we went further, and I do not think that we should gain any corresponding advantage. Upon that point I should like to hear an expression of opinion, whether it is desirable to seek an alteration of the Act of Parliament so as to remove the option given by the Public Health Act for a man to drain his own property. You may say that a man should be allowed to do as he likes with his own; but in many cases how long is the person who puts in the drains the owner? A speculative builder purchases a piece of land, and builds houses, and perhaps in eighteen months they are sold and have passed out of his hands into those of ratepayers, who have to pay in the ordinary way for keeping drains right. Suppose the original owner says it is not worth his while to put in these drains to last longer than will suffice just to get the street off his hands and adopted by the Corporation. The result is that in twelve or eighteen months after the house has been sold, the drains have to be taken up at the public cost, of which the new owner as a ratepayer has to contribute his share. If the public has to pay eventually for making proper drains, in the place of the jerry work too often put in in houses and streets, it would be better that they should pay in the first instance. Let the ratepayers take a share of the first cost and see that the work is properly done. Let the work be done by the Corporation, and let them charge the owner 75 per cent. of the cost and pay the rest out of the rates. Though the ratepayers would thus pay 25 per cent. of the original cost, the actual cost of the drains will be no more, but perhaps less than before. I have digressed a little from the scope of the paper, because this is a matter in which I feel particularly interested, and perhaps speak rather freely when there is the chance.

Mr. McKie: Might I be allowed to make a few more remarks before Mr. Spencer replies? As to cast-iron pipes I will say nothing further, except that, in my opinion, cast-iron pipes properly coated are the pipes of the future, so far as interior work is concerned. In America they are using cast-iron pipes in lieu of earthenware pipes, and I am quite sure that cast-iron pipes are the right thing when properly coated. I know nothing equal to the Bower-Barff process, where the black oxide of iron becomes part and parcel of the pipe, and, as far as I have used such pipes, they have proved very satisfactory indeed. For further protection they could also be coated with Dr. A. Smith's composition. Then, as to self-

acting flushing, I am trying to get it arranged for in my own city. We have to pay for flushing sewers; but why not make the flushing at the fountain-head, namely, at the dead end of each private drain? If this is done thoroughly it will flush the main sewers more perfectly than at present. Then the cost of flushing private drains and main sewers would be one and the same operation, and would be more effective. The bath and lavatory water for automatic flushing could be utilised, and, if not sufficient, eked out with town water. Then we have had for four years a resolution of the Town Council, stating that no one shall be allowed to put in a private sewer in a public street. The resolution is something to this effect: that the sanitary authority shall put in all private sewers to the boundary wall of every property in public streets. I was the means of getting this passed, for this important reason; that where streets were opened by private persons for the purpose of laying drains to private property the surface of the street was not properly reconstructed. The junction with the main sewer and the drain to the outside of the curtilage of the property should, in my opinion, certainly be done by the local authority. The outlet, or connection with the sewer, ought to be as perfect as possible. At the same time I quite agree with the President that it is a very difficult thing to take any responsibility inside the curtilage.

Mr. Godfrey: If domestic flushing of drains was adopted it would greatly improve the flushing of sewers too. What we suffer from is imperfect private drains. If they were kept in good order the main sewers would also be in good order. In cottage property, where there is a common supply, a flushing tank that would hold 50 or 60 gallons, and go off automatically, by catching the droppings from the tap, would keep the whole of the yard clean without trouble and without cost. I have put in several of these large flushing tanks, and have found that they answer completely.

Mr. Davis: It occurred to me whilst Mr. McKie was speaking of the flushing of private drains being made effective for flushing public sewers, that this could be rendered more effective if these automatic flushing tanks were made to go off simultaneously. If this were not the case, the domestic tanks capable of flushing drains would do very little good when their contents reached the public sewers. Unless a number of them went off simultaneously the flushing of the sewers would not be effective. Then, with respect to the discussion yesterday, on the point as to whose duty it is to

inspect the drainage of old houses, I think a little further explanation is required. I should myself be very glad to hear the opinion of those who have had greater experience as to whether it is the duty of the surveyor to the authority or of the inspector of nuisances to inspect the drainage of old houses erected previous to the passing of the Public Health Act. I should be glad to elicit some information on that point.

Mr. White: I do not know whether or not I am qualified to answer for the Association the question Mr. Davis has asked; but, as far as I know, it is not the duty of the surveyor or inspector of nuisances to overhaul the drainage of existing houses, unless a nuisance is complained of. Subject to correction, I believe that is the true state of the case. Supposing a nuisance from defective drainage is complained of, I should take it to be the duty of the surveyor to examine and report upon the premises, but no ratepayer has a right to call upon him for a report in the same way that he would call upon an engineer in private practice.

Mr. Davis: I am speaking of a case where a nuisance has been complained of.

Mr. White: Then I should say, clearly the surveyor would be the proper person to inspect the premises.

Mr. Davis: I know there is a difference of opinion on this point, and the practice is different in different towns. In Stratford-on-Avon the inspector of nuisances is frequently called in to report on the drainage of a house or a school, &c., and he in turn calls on the medical officer of health, who considers it his duty to report upon the whole system of drainage. He even goes further, and directs what remedy shall be adopted. I have heard that in other towns the practice is different. In some, as Mr. White has just stated, the surveyor inspects and directs what shall be done to remedy any sanitary defects. In my opinion that should be the practice. The inspector of nuisances should find out existing nuisances, but it is for the surveyor to direct the remedy to be adopted.

Mr. Gordon: I should just like to make an explanation with regard to something which took place during the discussion of this paper yesterday, and at the same time I will state what is done at Leicester with respect to the inspection of old houses—the point just raised by Mr. Davis. Mr. Jerram promulgated the idea that it was the duty of the sanitary inspector, and not of the surveyor, to take in hand the inspection of houses where nuisances had been complained of, and to prescribe what remedies should be

adopted. I followed Mr. Jerram, and was followed by Mr. Hall of Stockton, who seems either not to have heard what I said, or to have misunderstood what I did say. He coupled me with Mr. Jerram, and expressed surprise that I had, with Mr. Jerram, promulgated the idea that it was no part of the duty of a town surveyor to undertake the inspection of the sanitary condition of old houses. I am sure that every gentleman who heard what I did say could not possibly have so misunderstood my remarks, because nothing was further from my intention than to give such an impression as that stated. What I intended to say, and I find it very correctly reported in the *Newcastle Daily Chronicle*, was that it was clearly the duty of surveyors of towns to see that the drainage of new buildings is properly carried out, but that in large towns the surveyor should not be expected personally to see every drain laid, and that such towns should provide the surveyor with a sufficient number of qualified inspectors to see the work done—the surveyor of course being responsible. I also intended to convey the idea that the sanitary inspector who inspects older houses should be under the control of the surveyor, who would be the really responsible person. I pointed out a difficulty I need not repeat to-day with regard to old houses, but it may be useful just to say what we do at Leicester. We have two sanitary inspectors, and they have the duty imposed on them by the Sanitary Committee of making a house-to-house inspection of existing premises. Every house is visited, and if there be any objection on the part of owners or occupiers to the sanitary inspector entering any premises, then a notice is served which you will find provided for in the Public Health Act, stating that the inspector will inspect the house on such and such a date. After the receipt of this notice there is generally no objection on the part of anyone. If there should be any difficulty, of course further action is taken. But, as a rule, a large amount of their time is spent in attending to houses about which complaints have been made. The whole of the reports of these inspectors are submitted to me; but the inspectors are, of course, now pretty well qualified to tell, when they find any sanitary defects in a house, what the remedy should be. But if they find any difficulty, the borough surveyor has to go personally and inspect the premises. This becomes an onerous duty in large towns, and consequently, at Leicester, there has been added to the two original inspectors of nuisances a third chief inspector who is

a properly qualified civil engineer. Notwithstanding this, I am myself, as surveyor, personally responsible; every notice goes out in my name, and if any action is taken in any court, it is in the name of the surveyor, and I have the direction of it. I see the reports before they are presented to the Sanitary Committee. The view I intended to convey yesterday was, that the surveyor of a town must be its chief sanitary officer, but where he cannot attend to everything himself personally, he must be provided with a sufficient number of qualified assistants and sanitary inspectors. I wanted also to point out the difficulty with regard to old houses, which has again been referred to this morning, where the medical officer appears to act as chief sanitary officer. If you have any complaint of a nuisance, and go to the house and find an unsanitary state of things, but the occupier will not admit there is any nuisance, you have great difficulty in proceeding against anyone. It is here, I am sure, that we want some alteration of the law. The surveyor ought to know better than anyone else—better I think than the medical officer, though he should support the surveyor sometimes—when he has inspected a house, whether the premises are or are not in an unsanitary condition. If in the opinion of the surveyor a house is in an unsanitary condition, but no one will admit that there is any nuisance, you will, as I stated yesterday, find great difficulty, should you go before the magistrates, in getting any remedial sanitary works enforced as the law at present stands.

Mr. Hall (Stockton): I certainly did misunderstand Mr. Gordon yesterday, but immediately after we left the room he explained his view to me, and I saw I was mistaken. I objected to such a suggestion as that advanced by Mr. Jerram, and thought it my duty to protest against it. I am glad to find, since I made my remarks yesterday, that Mr. Gordon and myself hold the same view on the subject.

Mr. Escott: I wish we could, as Mr. McKie suggests, get power to put the sewer to the boundary of a property, under the direction of the local authority or corporation. No doubt there are great objections to allowing every builder to pull up the streets and put in sewers. We do not allow drains to be put underneath houses, so that if the Corporation laid the drains as far as the buildings, all drains would be under the control of the Corporation. The main difficulty is about charging for branch drains. Mr.

McKie did not mention whether the resolution of his Council gave him power to charge the cost of branch drains upon owners of property.

Mr. McKie: Yes; and in each case the owners sign a book agreeing to pay for the work.

Mr. Escott: I shall endeavour to carry it out.

Mr. Eayrs: The practice at Walsall is similar to what Mr. McKie has stated respecting Carlisle. All branch drains are laid by the Corporation to the boundaries of properties; not only do the owners sign a book agreeing to pay the cost of the work, but the surveyor prepares an estimate for doing it and the money is actually deposited before the work is commenced.

Mr. De Courcy Meade: I introduced the same system in my district, which adjoins the Metropolis, as that enforced in the City of London, where they have power to put in the sewer to the line of frontage. We, at Hornsey, are under the Public Health Act, and I am sorry we have not this power; but we have exercised the power on our own responsibility, and in no case has it been disputed. When a drain is required, the builder goes to the office and deposits a plan for the approval of the Board. I then furnish him with an estimate of the cost of the drain from the sewer to the line of frontage. The estimated cost of the drain is paid by the builder to the clerks' department. When I get a certificate from the clerk that the money has been paid, I give orders to the Board's contractor to put in the drain, which is done according to an annual schedule of prices. We find this arrangement works very well, inasmuch as it relieves the builder from the responsibility of lighting, watching, and making good the public way, and also from sending for the surveyor to inspect the drain in short lengths, which would otherwise be the case. We also charge a certain sum for making good the surface of the road where the drain has been laid, and for keeping it in repair during subsidence.

Mr. White: I should like to ask whether we are not wandering from the paper. It appears to me that we are doing so, to a very great extent.

Mr. Fowler: The difficulty is to define where the duty of sanitary inspector ends and that of the surveyor begins; and I think this Association should strive to determine exactly where the duties of the medical officer of health should terminate. For instance, take the model bye-laws; under them you have notice that a house is ready for inspection, but when you go to it you find

that the plastering is wet from the roof to the cellar. There is nothing in the bye-laws, however, to prevent the house being occupied because the building in this respect is unsanitary. What, then, are you to do? You simply say to the party, "I cannot allow you to occupy this house until it is perfectly dry;" but if he should prove stupid, you would have to call in the medical officer of health. Then comes the question as to where the duties of the two officers begin and cease. My idea has always been that the medical officer of health should have all the sanitary inspectors under him. The duties of the borough engineer are accumulating every day, and not only that, they do not tie down to within the four corners of the Act, but impose upon him all manner of duties. The duties are very onerous, and I think it should be distinctly understood that the medical officer should really see to everything connected with the inspection of sanitary matters. I think if we laid down the principle, that anything pertaining to the building, and all structural works, should come under the duties of the borough surveyor or engineer, and then let the medical officer of health see to all other matters, it would be satisfactory. Associations are being formed to inspect houses and their sanitary arrangements, I think for the fee of a guinea. There are two such associations in Manchester, and I must say I think this is *infra dig.*, so to speak, to the sanitary inspectors of large corporations. Surely if people pay rates to keep the sanitary condition of their houses perfect, it is not right that they should have to pay another guinea, or two guineas a year, to have their houses inspected regularly by a private association. That would be putting a second rate on them, and I think we, as borough surveyors, should see that the Act of Parliament is carried out strictly under our cognisance, and not allow other bodies to interfere. I am in private practice, as well as a borough surveyor; but, speaking impartially, I think the surveyor should have everything under his cognisance.

Mr. Lobley: The title of the paper will clearly warrant my referring to the making of the drain between the sewer and the house. Mr. Meade has stated that he has adopted a rule by which the local authority does this work. I have adopted the same rule for many years past, and it has worked well. There is a clause in our bye-laws which states that all drains laid shall be seen and inspected by the surveyor before they are covered up. Should a builder object to the Corporation doing the work, or to paying the money beforehand, all that would be necessary would be to insist

upon seeing every pipe before it was covered up. The consequence would be that, when the builder had laid a few pipes, he would have to send notice to the surveyor, and leave them uncovered until they had been inspected. He would have to do this several times, and thus it would be very much more costly to him than paying the Corporation for the work. It is extremely rare for anyone to resist this rule that I have made. As to whose duty it is to take a case into court, it depends under which part of the Public Health Act action is taken. If taken under the clauses incorporated from the old sanitary Acts, it should be the sanitary inspector, but if under the early clauses of the Act, then it should be the surveyor, who is there expressly mentioned. Mr. Davis suggested the simultaneous action of all flushing tanks of private houses. It is impossible to say what the future may bring forth, and it is difficult to foresee what progress may be made, but it is certainly a fine field for invention to make all self-acting flushing tanks go off at the same moment. There is a chance for some one to distinguish himself if he can accomplish this.

Mr. Spencer: I am sure that many of you, like myself, must have listened with very great pleasure, and considerable profit, to the very interesting discussion which has arisen upon this very simple paper. It is impossible for me to deal specifically with the various points raised during the discussion, which has ranged over a material portion of two days, but I will just touch lightly on one or two, and that is all that is necessary, because the discussion has really been of such a detailed and complete character that it requires very little to be said by me. I will therefore just make one or two concluding remarks, and touch upon such points as I think necessary to bring the consideration of the subject to a proper conclusion. Mr. Jerram, the first speaker, considers that the number of houses I stated could be inspected by one man in a year is very small. He thinks that from 1000 to 1200 might be inspected; but all who have had experience in the inspection of houses will know that to thoroughly inspect all the sanitary arrangements of a house will occupy probably the greater part of a day. It is true there are small cottages where there are simply drains to be seen to; but when I say that 400 is the average number of houses for one inspector, it is not a mere guess, but the result of the actual experience of many of the most competent inspectors and borough surveyors throughout the country. Mr. Jerram also raised the question whether this was not more within the range of a sanitary

inspector than of a surveyor. I think, from the discussion which has arisen, it has been pretty plainly indicated that in the opinion of this meeting, it is entirely within the province of the surveyor. With that I myself entirely agree, and it has surprised me that it has not occurred to any of the various speakers to allude to one thing which I think settles the question. And that is that in very many instances the surveyor to the local authority is also himself inspector of nuisances. Then, with regard to earthenware pipes under houses, it has been stated by some of the speakers that if properly laid in concrete, they would be sufficient. For my own part, I have seen such concrete, either from the settlement of the soil, or from expansion of some kind, cracked in such a manner as to allow sewer gas to escape; when concrete gives way in this manner sewage gas disengages itself. Mr. Newman thought it unnecessary to go to the expense of a disconnecting manhole between the drain and the sewer. No doubt, where a drain is very deep, the expense would be a very serious objection; but unless the drain is shallow a mere syphon disconnecting trap is liable to be impaired in efficiency in consequence of the very long circumscribed communication to the outer air. Therefore we have to contend either with expense or inefficiency. After reading my paper yesterday, my attention was directed to a syphon trap downstairs, invented and registered by Mr. Newman, which is so constructed as to allow of a disc being put in so as to fill the house-drain with surface-water, and thus make it as it were a self-testing drain. That seemed to me a very ingenious and simple method of accomplishing one of the tests which I have suggested in this paper. I think this trap downstairs is well worthy of the attention of every gentleman present as he leaves the building. Mr. Allison, of Manchester, also made one or two remarks. I think I am not going too far when I say that these remarks were distinguished chiefly for their inconsistency. Mr. Allison was rather hard on Mr. Jerram for suggesting that this duty is one which comes within the province of the inspector of nuisances rather than that of the surveyor. Then Mr. Allison said that really the substance of this paper was beneath the notice of surveyors. That struck me as being almost the very acme of inconsistency. I think every gentleman of intelligent perception must have seen that the whole object of this paper was not so much to lay before the Members anything new, or that they were not previously well acquainted with, but that it was intended to be a mere peg on which to hang a very valuable and practical discussion.

Mr. Allison, however, did not see that. The result has certainly shown that bringing before you a subject which deals simply with the everyday duties of our profession, really evokes the best and most useful discussion. One thing is very certain, that this subject is being taken up very largely by the public. We have heard yesterday, from Mr. Fowler and others, about the formation of associations in this country for dealing with the question. This was in my mind when, at the request of the district secretary, I consented to write this paper. I knew that public interest was being roused, and I thought I should be doing service to this Association by bringing this question forward and directing our attention to a subject which might otherwise be taken out of our hands by private associations and private practitioners. As to whether a man is in private practice or not, that is merely a secondary matter. When a Member reads a paper before our Association, clearly his object should be to bring before you the aims and object of your duties. It was therefore far more with the view of raising a discussion, and drawing attention to a very important subject, that I read this paper, and also for the purpose of ascertaining whether borough surveyors and surveyors of local authorities throughout the country, are alive to what is going on outside. I am perhaps a little diffuse, but the status and position of borough surveyors is a question which vitally concerns us as sanitary and municipal engineers. Whether we are supplemented by private associations, or whether the matter falls into the hands of medical officers and inspectors of nuisances, at any rate, in bringing the matter before you, rousing your attention to it, and eliciting your opinions respecting it, I had the welfare of our profession and Association at heart. There were many other speakers besides those I have noticed. Mr. Gordon, Mr. McKie, Mr. Parry, Mr. Laws, Mr. Escott, and others carried on the discussion with the ability which enables men of intelligence to discern the important principles and developments underlying the most simple duties, while men of denser mould are too apt to relegate them to the category of commonplace routine. One point which struck me particularly was raised by Mr. McKie, and was ably developed by other speakers. Nothing, I take it, can be more inefficient than the present system of pouring two or three gallons of water down a drain. This is called flushing a drain, but it really is no more flushing than pouring water from a small hose-pipe is. What is wanted is domestic flushing tanks. Whether they should be placed

in the houses, or at the heads of drains in back streets and courts, is perhaps a question for consideration. It has been very properly objected by Mr. Davis that domestic flushing tanks in houses might fail in fully effecting their purpose because necessarily intermittent in their action. But I think, if self-acting flushing tanks were placed at the heads of drains in back alleys and courts and passages that objection would be done away with in a great measure. It is also quite clear that, at the head of certain main sewers, very large self-acting flushing tanks ought to be constructed. This question is one of the very greatest importance, and, though it is very unsafe to prophesy, I venture to predict that, in discussing it to-day we have been legislating. This is one of the questions which will have to be brought to the front and be dealt with in a practical manner. With respect to Mr. Fowler's suggestion as to distinctly defining the duties of the medical officer of health, the sanitary inspector, and the surveyor, I would not myself clearly define their duties, or draw any hard-and-fast line. My opinion is that all these three officers should work together. The one should be called in when necessary to aid the other. It seems to me that it is seldom practicable for one officer to carry out his duties satisfactorily without frequent and constant consultation with the other. In serving notices, carrying out necessary sanitary works, and remedying evils, they ought to work together and play into each other's hands. It would be a bad thing for any borough, if the lines were drawn so hard and fast that one officer could work independently of the other, if he wished to do so. It only remains for me, sir, to thank you and the gentlemen assembled here generally, for their kindness and courtesy in the reception and discussion of this paper. I was particularly careful when I commenced to read it, to state that I had nothing new to lay before you. It was my particular wish to make it perfectly clear that probably everything I had to state was already well known to you. But it cannot be intended that everything brought before you in a paper must be some new invention, idea, or fad. I take it that the subject of a paper should refer principally to our ordinary course of duties, and then by means of discussion we may gain new ideas, and obtain valuable and useful information respecting our every-day work. I am certainly self-sufficient enough to think that the excellent and prolonged discussion which has taken place to-day, has verified the correctness of my view on this subject.

A vote of thanks was accorded to Mr. Spencer for his able and interesting paper.

"THE BEST PRACTICABLE AND AVAILABLE MEANS OF RENDERING SEWAGE HARMLESS."

By ALFRED S. JONES, V.C., Lieut.-Col., Engineer, Wrexham.

It may be worth while to consider the extent and bearing of these carefully chosen words, which form the basis of "The Rivers Pollution Prevention Act, 1876."

At first sight the expression may seem vague, and perhaps less satisfactory to lawyers and theoretical minds than any definite standard which the chemist might lay down; but practical results must form the real aim of all who are interested in the improvement of our rivers, and it seems to me that such results can only be obtained by allowing a certain elasticity to the law's requirements.

If a hard-and-fast line were to be laid down, with any real desire that it should be enforced, that line would naturally be drawn in such a way as to touch only the worst possible case of river pollution, and all effort for the attainment of any better state of things would be discouraged by the fact that an appeal to such a low standard could be made by any dissatisfied ratepayer.

A high standard is, *in certain cases*, at present unattainable, and to enact it would simply bring the law into contempt; whereas popular feeling will always support a practicable and available measure. Here, of course, a great element of uncertainty and litigation might arise, but practically the latter is generally avoided, from a mutual desire to demand and supply what may be considered a reasonable compliance with the spirit and intention of a declaratory Act which sets up no impracticable standard.

The field is left open for voluntary effort at improvement, and a stimulus afforded without actual appeal to the Act, just as was the case in many parishes on the passing of the Education Act, 1872, where existing schools were incited to improvement and extension without recourse to machinery provided for by the statute.

Enthusiastic advocates for compulsion to adopt irrigation, inter-

mittent downward filtration, or precipitation processes, have been chilled by the cold blast of practical experience; and it is now generally admitted that the contest between the various systems has only been a drawn battle, because differing local conditions, rather than intrinsic merits of those systems, should determine their selection or rejection in each case.

Where suitable land can be obtained at reasonable cost, and its irrigation can be properly conducted, there need be no doubt as to the policy of adopting that mode of dealing with the question both on sanitary and financial grounds. But such favourable conditions for obtaining the maximum of purification are often wanting, and some measure of clarification by precipitation or simple deposition may, in some such cases, constitute the "best practicable and available means for rendering sewage harmless."

Again, the sewage, or its partially clarified effluent, may in some cases be safely and cheaply discharged into the sea, or into a volume of fresh water relatively large enough and sufficiently charged with oxygen to render such sewage matter harmless. I am anxious to elicit an expression of opinion from the Association on this question of the expediency of adopting the elastic standard as opposed to any hard and fast one; but at the same time I must admit that, in the interest of riparian proprietors and others concerned, it would be well for the Local Government Board to put forth some practical advice for the guidance of the sanitary authorities, with whom the choice of remedies for existing evils must ultimately rest.

At present there is a strong disposition on the part of central authorities to throw all responsibility on local ones, but to stand behind the scenes hampering and impeding every effort at independent action which may be manifested by the latter, and the local boards, on the other hand, are apt to lean too much on the broken reed of a Government enquiry as at present conducted; in fact, if we look for a parallel and example of the relations of a sanitary authority with the Local Government Board at Whitehall, we may find its *reductio ad absurdum* in those which have existed between Downing Street and Egypt for the last two years.

On the contrary, I maintain that the central authority ought to give advice and protection to subordinate bodies, inasmuch as the latter can seldom obtain the wide experience required to ascertain what are the best practicable and available means, without going through greater tribulation and expense than can be expected to be incurred by ratepayers or their representatives.

We have long experienced the benefit of Sir Robert Rawlinson's "Suggestions" on sewerage, drainage, and water supply, and doubtless such an authority would be equally successful if it extended to sewage disposal; but the Board has hitherto feared to enter upon the arena of strife between systems and creeds on this disputed subject. There is, of course, a greater uniformity in the arrangements for sewerage and water supply, which makes it easier to issue such authoritative "Suggestions," but it seems to me that the time has arrived at which certain general suggestions could be formulated (on the Disposal question) without unduly interfering with vested interests, and that the engineering staff of the central authority might supplement such printed advice by special reports for the assistance of local boards and of the county court judges, who, under the Act, may at any time be called upon to decide whether the best practicable and available means have been adopted and are being enforced.

It will be observed that I do not recommend any departure from the principle of local self-government, for it would still be open to sanitary authorities to take the advice or disregard it at their own risk, and the county court judge would be equally independent; while I believe that in the majority of instances authoritative advice would be welcomed by all parties concerned, as most economical and efficient, and that it would be the means of saving heavy legal costs, which are often incurred to very small purpose. Speaking for myself, as one who has undertaken the responsibility of providing sewage disposal for nineteen years, of which twelve have expired, I can only say that I should welcome the visits of any Government inspector as an encouragement to my efforts to comply with all reasonable demands for the purification of the sewage of 10,000 people, and I imagine that others in a similar position, whether boards or individuals, would be animated by the same spirit.

The Act of 1876 provides, indeed, for the appointment of inspectors, but we hear of little action being taken by those who fill that office; and probably this arises from the limited powers delegated by the Act, which amount only to the granting of certificates of temporary indemnity in certain cases in which the law may be infringed.

Borough surveyors may be well acquainted with their own districts, but it is too much to expect such officers in all cases to get up the minute details of sewage disposal, and be always in a position to satisfy their own board and all comers that some one

plan is the most advantageous; hence we find deputations from town councils going about the country to inspect different sewage works and farms, to return little wiser than they set out, because it is quite impossible for amateurs to gain useful information on the subject by any such peregrinations. If they sent their surveyor alone, and gave him time and discretion, he would doubtless make a proper selection; but, as a rule, no man is a prophet in his own country, and I find that boards prefer to take an "outing" themselves on these occasions, when their pleasure greatly interferes with the surveyor's opportunities of informing himself as he would do if sent by himself on duty.

It seems to me, therefore, that, with all respect to many of our Members who have made a *spécialité* of sewage disposal, there are others who would be glad to have their hands strengthened with their boards, by the power of appealing to an outside adviser, who ought to know more about the subject than members of the board, and who would have no local entanglements to warp his judgment as to the best practicable and available means in each particular case.

DISCUSSION.

The PRESIDENT: I have to ask the Association to allow a gentleman who is not a Member to address us on this subject. He has some information to give us which will be interesting, and I am sure that none will object.

Mr. HANSON (Wakefield): I feel very greatly obliged to the Association for affording me the privilege of making a few remarks. I have with me a machine which I desire to exhibit to you. In Col. Jones's paper I find he alludes to a standard. Of course we have not a standard for the purification of our sewage water. There has been a standard attempted to be fixed, but it is such a very high one that we cannot attain to it. I hold we should have such a standard fixed as all local boards could afford to carry out. If we render sewage and water polluted by mills so clear that it looks like spring water, so good and soft that manufacturers can use it over again, and, further, so pure that fish will live in it, and cattle may drink it with impunity, I think that should be sufficient. But if we are to get to such a standard as some of our great chemical authorities require, it would have to be pure water. Col. Jones in his paper refers to intermittent downward filtration,

and precipitation process. At one time all persons seemed to depend on irrigation, which was almost forced upon us; but our climate is wet and humid, and clay land is supersaturated with water and does not require irrigation. Further, in Lancashire and Yorkshire we have so many hills that irrigation would in many places be impossible. Now precipitation has come to be admitted, but an embargo is placed upon it, as it should be subsequently treated by passing it over land. Another plan is to let the sewage water run into the sea. Sewage water running into the sea is a great nuisance. As soon as sewage mixes with the salt water of the sea, it chemically decomposes, stinks very much, and is very foul indeed. When the tide is up, and there is very little fresh water running down, the water from the sea is exceedingly salt, and sewage water running down then becomes very obnoxious and stinks abominably. Now black ash waste will deodorise sewage altogether from the effect of this. Having been partially made from common salt, and sea water being highly charged with salt, there is an affinity at once formed, which causes sewage water to mix readily with the salt water, and of course it is deodorised immediately, and there is no evil effect from that. Col. Jones refers in his paper to deputations. As a sewage treater, and having a great many sewage works under my care, I find it a very expensive thing to have to attend to these deputations, without any profit. I would much rather see one engineer or surveyor than any deputation. The best way of dealing with sewage I say is precipitation, with as little cost, and as quickly as you can get it done. Newcastle I find is a town on a tidal river, and should never put down sewage works at all, for they are not required. There is plenty of black ash waste in the neighbourhood, and I am informed the Corporation own twenty-five acres of land which is covered with it. If the black ash waste was removed the land would be worth 6*s.* a yard, but as it is, it is not worth anything. All that the Newcastle Corporation has to do is to take this black ash waste and throw it into the tanks, and take the liquid in water-carts and let a certain quantity of it into the sewers through grate-holes, and they will have no sewage gas. The sewage gas would be immediately fixed, and there would be no necessity for flushing. Then the sewage water would run deodorised and perfectly harmless into the tidal river, and all would be carried away. The next best method, where you are obliged to have treatment to get rid of the solids, is to treat the sewage first

chemically, and by downward intermittent filtration afterwards. You should have as small works as possible, have the least expensive machinery that will suffice, and adopt the least costly method of treatment. I have such examples at Slaithwaite, at Golcar, and at Aldershot, where my automatic machine for the treatment of the sewage with chemicals is at work. At Golcar it does not cost 5*s.* a week for attending to the machine.

Mr. Hanson then exhibited and explained his sludge-lifting machine, and said that the effluent water from the last tank, by falling upon two water levers, lifted the sludge and cast it wherever it was required.

Mr. Vawser: The point which Col. Jones has submitted to this meeting is, whether the Local Government Board should lay down a standard of purity to which all new sewage works should attain, or whether there should be what he calls a more elastic system, and that different systems should be applied to different towns according to their respective circumstances. He also suggests whether the Local Government Board should not themselves formulate some conditions and requirements for the guidance of local authorities. Although Col. Jones's name is to some extent associated with the purification of sewage by irrigation, he may be understood to suggest that there are other means of purification applicable to certain towns; I agree with him that irrigation is the best and most practicable means of rendering sewage harmless where you can get suitable land at a reasonable price, but there are many places in manufacturing districts where this is not possible. In almost every large town irrigation has been proposed, but the large quantity of land required, and the enormous quantity of sewage to be disposed of has sometimes rendered that system impracticable. I venture to think, instead of the Local Government Board laying down hard and fast rules for our guidance, it would be better for them to allow free trade in matters of the purification of sewage; and when a scheme of irrigation is submitted to the Board, and it contains the elements of prudence and the sewage could be treated and purified to a reasonable degree of purity, the Local Government Board should have no option but to approve of it. On the other hand, when a scheme of chemical treatment is submitted, the Local Government Board should approve of it under similar conditions, and they should not attempt to enforce the same system for all places alike. A few years ago if one submitted a scheme for purification by a chemical process it would have been rejected at once,

and I think if one were now to propose a scheme of irrigation it would probably receive the same condemnation. It is exceedingly difficult for a Local Government Board inspector to select the best system during a very short local inspection, and the judgment of the local engineer should have full weight with the department. It is well known that some eminent engineers have a predisposition for some particular system, and as the gentlemen who report to the Local Government Board are hardly free from a similar feeling, it would be extremely difficult to lay down a strict rule for observance, as all systems are more or less perfect when judiciously adapted to the special requirements of the district under consideration. My point is to suggest that we want absolute free trade in sewage; that so long as a scheme presents a reasonable system for dealing with sewage, that system ought to receive the sanction of the Local Government Board. This is really a point that all engineers should contend for. Let us have the opportunity of judging for ourselves what is the most suitable system for our district; then let the Local Government Board approve of it, and throw the responsibility of it upon the local authority and its professional advisers.

Mr. Pritchard: Col. Jones has no doubt made some divergence from his views at previous meetings when we have discussed the question of sewage treatment. Some gentlemen may be of one opinion and some of another, but we have in this paper something healthy and new—something to grasp and consider. As pertinently put by Mr. Vawser, the question is whether we shall have absolute free trade in sewage. I quite agree with Mr. Vawser that it should be so. Most of us, I dare say, have experienced difficulty in dealing with sewage matters, in consequence of differences of opinion with the central authority. The author of this paper and myself have recently been engaged in matters of great importance with reference to the purification of the sewage above London from the very large district from Esher down to Barnes inclusive. It was proposed to deal with the sewage of 120,000 people within a few miles of Hyde Park. I am speaking of the Lower Thames Valley Drainage Scheme, which received its quietus on Wednesday afternoon last. As you are probably aware, this United Drainage Board was formed in 1877, at the same time that another important Drainage Board was also formed, the Birmingham, Tame, and Rea. Since that time this difference of opinion has cost that Drainage Board something like 50,000*l.* at the very least in trying to obtain

permission to deal with their sewage. Without going through the whole history of the Board during past years, it will be quite sufficient to refer to what has come immediately under my own notice. A scheme was proposed for dealing with the sewage of this district by precipitation at Mortlake. That scheme was very hotly contested. It was necessary to give notice last year for the purchase of the requisite land, under the Land Clauses Consolidation Act, and directly the notices were issued great opposition was evinced to the scheme. An inquiry was held by the Local Government Board, by the senior and able inspector, Mr. Harrison, M. Inst. C.E., and after fifteen days' hard fighting the inspector reported in favour of this huge scheme of precipitation at Mortlake. I would call Mr. Hanson's attention to the fact that without any application to the land the effluent water was to be taken direct into the Thames opposite Chiswick. The Local Government Board approved of the scheme, Parliament considered it, and it was referred to a parliamentary committee. That committee, although the Local Government Board has approved of the scheme, declined to hear the evidence against it, and threw out the Bill. The Board asked that they should be given powers for the purchase of the land; and also that they should be allowed time, but both Bills have been thrown out. I only allude to this matter to show that the Local Government Board and the Government of the country disagree as to the disposal of sewage; therefore I say the sooner we have free trade in sewage the better. I feel sure that Col. Jones's little paper will give rise to a very interesting discussion. Col. Jones has had very considerable experience in dealing with sewage, and he has treated sewage most successfully under very great difficulties. I see he has given up as hopeless the separate system, but perhaps he considers that it has been so well received by engineers in general that it is not necessary to press it any further. Mr. Hanson has submitted a nice piece of mechanism for lifting sludge. That is all very well in its way, but Mr. Hanson will bear in mind we have frequently cases where the invert of our sewers is at a considerable depth. In the Lower Thames Valley it was 19 feet below the Ordnance datum line; and there Mr. Hanson would have had some difficulty in working his machine. I should be very chary about offering any advice respecting dealing with the sewage of Newcastle, but I have no doubt, Mr. President, that you are deeply grateful for the suggestion which Mr. Hanson has kindly made. I must say that I should like to know something more of the black ash, and of the

results of the analysis of the effluent water after sewage has been treated by it. I should like to know what black ash is, and whether the process is one which requires absolute rest and quiescence? I will sit down with the understanding, like Mr. Vawser, that we are to have free trade in sewage, and I hope that day will soon come.

The PRESIDENT: Perhaps Mr. Hanson will tell us what black ash is, and what is its chemical effect on sewage.

Mr. HANSON: It is a bye product from the manufacture of soda. Having described the process of making common soda, he said: the black ash waste which is left has hitherto been of no value. When new it is insoluble, but after it has laid in mounds for some years it becomes oxydised, and is changed into a mono-sulphide of calcium. I am often asked how it is that black ash waste purifies sewage. My reply is, that it is not for me to prove how it does it, but to prove that it does it. The system has been tried at Golcar, Slaithwaite, and many other places, and at Leeds, after competition with twenty other systems, including that of the Native Guano Company, was pronounced the best.

Mr. PRITCHARD: What about the analysis of the effluent water? I am anxious to hear something about that.

Mr. HANSON: I have not the analysis here, and I do not think it is necessary, for this reason—there were something like twenty-four competitors or schemes at Leeds, where the trials were most carefully conducted, and twenty-four fresh samples of the various effluent waters were taken every hour. These twenty-four bottles were mixed, and one bottle was then put on a shelf, as representing fairly the effluent of twenty-four hours' precipitation. This went on daily for fourteen days, and the fourteen bottles were then mixed, and a sample was given to me, and another was kept for analysis. The same thing was done with the effluent water of the Native Guano Company. The result was that my system was pronounced the best, the tests being, the best effluent water, the least cost, and the least quantity of sludge. Thus I obtained the victory, and the consequence was that my system was adopted in July 1876.

The PRESIDENT: It would be useful if you could give us the analysis of your final bottle.

Mr. PRITCHARD: It should be fresh effluent water, and not a sample kept for fourteen days.

Mr. HANSON: When sewage is treated by alum, or any other kind of chemical, you will find there is secondary decomposition,

but with black ash waste there is no such secondary decomposition. This was clearly proved by the test at Leeds. A sample was bottled, and also a sample of the effluent water of the Native Guano Company, and each was kept sealed up for six months. Then the A B C bottle was opened, and it stank most abominably; but when the Hanson sample was opened there was no smell at all. It has also been found at other places that there is never any secondary decomposition when the sewage has been treated with black ash waste.

Mr. FOWLER: Does not black ash fix the ammonia? Would not that account for the absence of any stink?

Mr. HANSON: If you put black ash waste into any smell whatever—in a liquid form, or even solid—you will find all stench is destroyed immediately. You have sewage gas in your drains and sewers, but it may be fixed immediately, before going many yards. If you use black ash waste, which is an alkali, and send it down your drains, immediately all vapours are fixed, and the consequence is, you have no sewage gas.

Mr. MCKIE: May I ask a question, because this black ash waste is new to me. What are its component parts? Are they always the same, and how do you manage to always put just the right proportion into your sewage?

Mr. HANSON: Fresh black ash waste when put on the mountain must be well patted down, otherwise the atmosphere will get in and set it all on fire by spontaneous combustion, showing thereby that it has a great affinity for heat and oxygen. Now when it has remained on the mountain three or four years it becomes oxydised and gets so thoroughly oxydised that if you throw it into sewage water the black ash waste gives off its oxygen into the sewage water, and it is oxygen that it requires to purify it. If you put in too much there is no harm done; you can only give it too little sometimes, but a very little purifies sewage water.

Mr. MCKIE: Then the purification is by the oxygen altogether?

Mr. HANSON: It has a certain precipitating power. It does not only depend upon the oxygen, but also upon the weight you have in the black ash waste to chemically precipitate the solids you have in the water.

Mr. FOWLER: The paper read by Col. Jones opens a wide field for discussion, and a similar question has been before the Association several times. The Blue Book of the Royal Commissioners, issued, I think, in 1874, gave such a very high standard of purity

for effluent water, before it should be allowed to pass into rivers, that it could not possibly be worked. For instance, Dr. Letheby gave it, that according to the standard, the rinsings from a tea-pot put into a gallon of water would not admit that water into a river; but he also said, if you put sewage into a bright stream to the extent of one-tenth of its bulk, if it runs three miles it would purify itself, and the stream would then be satisfactory for drinking purposes. At the time I was in Leeds this Blue Book was issued, and the Corporation had an injunction hanging over their heads for polluting the river with sewage, although, by agreement with the lord of the manor, under their Act of 1842, they had special power to turn the sewage into the river. In the face of this, however, Squire Ingram got an injunction against the Corporation, absolutely prohibiting them from pouring sewage into the river in an unpurified state. The Corporation then set to work and tried experimental works, which cost 10,000*l*. Then they entered into a contract with the A B C Company to deal with the sewage, which amounted to nine or ten million gallons per day. This turned out a very expensive process, and as Mr. Hanson had said, when the corks were taken out of the bottles of the samples of the effluent water, there was a very offensive smell. In spite of this I took some of the effluent water and some of the town water, and put each into a globe, and put three carp into each, and to my great astonishment, at the end of about six months one of the fish in the town water died first. It is a singular thing, but it was the fact; and one would think, if fish could live in water under such circumstances, that it was sufficiently pure to be turned into a river without creating any nuisance. Leeds advertised to the world for processes that would purify sewage effectively at the least cost. I believe Mr. Hanson's system turned out very satisfactory, and I believe an account of it is printed in the Transactions of this Society two or three years back. Indeed I think an account will there be found both of Mr. Hanson's and of the A B C system, as tested at Leeds. It is only, however, where there is sufficient fall from the sewage outfall to the river that Mr. Hanson's machinery could be introduced. In such towns as Newcastle, Blackpool, Hastings, and other seaside places, there has been a great deal of discussion on the foul state of the beach, from the sewage being poured into the sea. From Blackpool to St. Ann's you will find the beach strewn for four or five miles with refuse which has been washed back and cast upon the coast. At Newcastle for instance there are sewers discharging

into the river, and two years ago, at the Aberdeen wharf, there was a very strong stream of sewage discharged, and vessels fresh from the ocean were moored over it. We know that in London and other places people get accustomed to live under insanitary conditions; but where sailors are placed fresh from the ocean, and put immediately over the foul discharges from a sewer, there is, I say, danger of a very serious epidemic breaking out. I have no doubt that there are similar sewers in many seaside towns to which people go as health resorts; and I think it behoves this Association to call attention to these matters. The country is beginning to look to this Association for some results, and if we can by our meetings and discussions show that such places are defective in their sanitary arrangements, we shall be doing a public good, especially at this time of epidemics.

Mr. Spencer (Newcastle): Having unfortunately been called out of the room, I shall not presume to detain you long; but I hope this discussion will help to bring about the consideration of the great nuisance caused by pouring crude sewage into a river, whether navigable or otherwise, or even into the ocean itself. It must be obvious to all of us in this neighbourhood, where the river is the only receptacle for the untreated sewage of a large city, and for the sewage of five or six other large towns on its banks, that this question is one which needs the serious consideration not only of Newcastle, but of the district, and it cannot seriously be expected that smaller places will endeavour to mitigate this very serious evil unless the larger city takes the lead. I hope that this discussion, in the heart of Newcastle itself, will lead to the serious consideration of this most important question.

Mr. Gordon: I am very unwilling to prolong this discussion, but I have been somewhat interested by the innovation on the part of Mr. Hanson in introducing to us a new system—new at least to some of us—of dealing with sewage. It seems to me scarcely to belong to the paper we have before us, otherwise there are, I am quite sure, a great many questions which might have been put to Mr. Hanson, but which have not been asked. If we had had a paper on his system, there are a great many questions which would have had to be put respecting it. I am most concerned, however, as to what is to be the practical outcome of the discussion of this paper. If I understand the paper which Col. Jones has been good enough to read to us, put in a very simple form it is that, although, as we know, his views are largely

in favour of irrigation whenever that is practicable, he is now of opinion that there should be some alteration of the standard of purity for effluent water before it is allowed to flow into rivers. I think he is right in that, in so far as that a fixed standard will not be applicable to every case. Mr. Pritchard has given you an illustration of the difficulties of a Board which is constituted to undertake the drainage of the Lower Thames Valley. He has told you of the enormous expense which that Board has been put to, without the prospect at present of attaining any practical result whatever. I was present at one of the sittings on that bill by the parliamentary committee, and heard the cross-examination of a very eminent engineer who propounded a new theory, which, if correct, would apparently somewhat alter our ideas as to what the quality of effluent water turned into rivers ought to be. He stated that the best known process by chemical precipitation, by downward intermittent filtration, or by irrigation, could only eliminate 80 per cent. of the impurities of sewage. Therefore 20 per cent. went to the rivers. The witness accompanied his statement with this further illustration, that there was considerable misapprehension with regard to the pollution of rivers, because if only 80 per cent. of sewage impurities could be taken out, it followed that, if you had a stream that was four times the volume of the sewage, the raw sewage might be poured into it and it would not be more impure than the best effluent water from any class of sewage works. This means that, with a stream four times as large as the volume of sewage, you need not treat your sewage at all, based on the assumption that as the proportions are as one of sewage to four of water, you have the same conditions as in the best effluents, namely, 20 per cent. of sewage and 80 per cent. of water. That surprised—and Mr. Pritchard will bear me out—every professional gentleman who was in that committee-room. The committee at once saw, as I am sure all present did, that, if this statement was correct, nothing whatever need be done in the Lower Thames Valley. I will not deal with that statement further here, it will doubtless be dealt with fully elsewhere. I think Col. Jones has hit the nail on the head when he tells us there should be some more general understanding—that the effluent water from one process or another may be all right when passed into a river of possibly twenty times the volume of the sewage, but the same character of effluent water will not do where all the conditions are entirely reversed. In the Lower Thames Valley case, it was stated that, under the most unfavour-

able conditions, when the population of the district to which Mr. Pritchard has alluded had increased threefold, and there was a minimum flow in the Thames, there would still be a volume of river water twenty-two times greater than the effluent water from the Thames Valley drainage. Consequently an effluent water containing over 20 per cent. of impurities would become entirely harmless under such conditions. I will take a drainage area of a very different description with which I am well acquainted, of 147 square miles, and I will give you the minimum flow of the river which is actually taking place, as registered last week—400 cubic feet per minute. Now the quantity of sewage effluent poured into that river is somewhere at the present time, after the dry season—which gives subsoil drainage—about 900 cubic feet per minute. Thus an effluent water is being poured in of more than double the volume of the stream of water flowing in the river, and that is not a mountain stream, as at Blackburn, Coventry, and other places where they deal with the sewage by precipitation; it is a river consisting of a series of elongated ponds—a canalised river, each pond being about a mile and a half in length, between the locks. It will be evident that a standard of purity, perfectly admissible where the volume of river water to sewage is as four to one, or as in the case of the Thames Valley twenty-two to one, might be very unsatisfactory in such a case as this, and that if you apply a standard at one place, it certainly will not do at another. There are different systems of precipitation. You may adopt the Coventry system, the A B C system, or even Mr. Hanson's system, and you will find, under such conditions as I have described, that no precipitation whatever would be likely to prove entirely satisfactory, and you would have to resort to some other or further means of purification. It may be advisable, as Col. Jones has suggested, that the Local Government Board should issue some practical advice for the guidance of sanitary authorities. Col. Jones said: "It appears to me that the time has arrived at which certain general suggestions could be formulated (on the disposal question) without unduly interfering with vested interests, and that the engineering staff of the central authority might supplement such printed advice by special reports for the assistance of local boards and of the County Court judges, who, under the Act, may at any time be called upon to decide whether the best practicable and available means have been adopted and are being enforced." It would be very useful possibly to have such suggestions, but I am quite sure they could not

be of universal application. Therefore it comes back to something like what Mr. Vawser and Mr. Pritchard seem to think should be the case, that we should have pretty much free trade as to the matter of sewage disposal. Each local authority will have to find out the method best suited to its local conditions. I have had considerable experience of these matters abroad, and I only know that, whilst I and some others were very strong advocates for irrigation, I have now learned that there are conditions where it is next to impossible to adopt irrigation. Other methods must then be resorted to, and in such cases it must be left to the local authorities to do the best they can, and to select that system which, after careful consideration of the local difficulties, they may be advised to adopt. If they have to resort to precipitation instead of irrigation their difficulties will be very greatly increased. But we should do very little good by promulgating here any kind of fixed formula as to what effluent water should be. We must leave it to the local authorities, and I hope the difficulties in their way will be lessened.

The PRESIDENT: I should just like to say how thoroughly I agree with Mr. Vawser that we should have free trade in sewage. I do not believe in any general fixed rules laid down by any sanitary authority. In the matter of sewage disposal and dealing with sewage there are no two spots in this country where the conditions are the same. You cannot possibly have one rule which would apply to the whole. I think every place should have the opportunity of dealing in its own way, by its own local men, and certainly by its own officers, with the sewage of its district, and certainly any reasonable scheme should have the sanction of the Local Government Board. After all, the district has to pay for the scheme, and I think their own interests will make them see that their advisers have at any rate ordinary capacity. Certainly they and their responsible advisers are in a better position to judge what is best, under all the local conditions, than any other sanitary authority possibly can be. Mr. Gordon has told us of a statement made by an eminent engineer before a parliamentary committee, which seems to me a very extraordinary one. His statement may be perfectly right; I do not for a moment dispute that the effluent water may contain 20 per cent. of the sewage matter, but his deduction is a most extraordinary one, because all systems of chemical purification and precipitation go on the principle that the good you get is as much by altering

the condition of the constituents as by what you actually take out of the sewage. You may take out of drinking water all suspended ingredients, and you may oxidise it, and the chemical analysis will give you the same result at the head of the supply as at the point of delivery. Yet the one may be a perfectly good and wholesome water, and the other may not be suited for domestic use. So you may alter the constituents of sewage so that the 20 per cent. left in the effluent shall really not be more noxious than one per cent. of the original. Thus his statement, that to mix the sewage with four times its volume of water would render it as harmless as ordinary effluent water, is simply absurd. There is another matter in Col. Jones' paper, which is rather a delicate one—where he refers to deputations; I am quite sure that what he has said on this subject must go home to all our hearts. We have probably all seen and know something about deputations. We do not grudge the gentlemen who compose them their enjoyment; it is indeed a great pleasure to me to see them happy and the pleasure they derive from their visits. But as to what use they are, I will not say anything further.

Col. Jones: In the first place I have to thank Mr. Hanson for the account of his precipitation plan, which he has hung on the peg afforded by my paper. I hardly anticipated that line of discussion, but I am very glad to have heard a bit about the black ash system, which I have heard of for some years, and to which I have been rather attracted. I have rather favoured the system, because it makes use of waste products, which are a great hindrance and in the way. Black ash is also a perfectly harmless ingredient as regards the sewage effluent, and therefore I think it is superior to lime in that respect. But as a clarifier or purifier of sewage, I think Mr. Hanson, probably like other inventors, is inclined to give it too high a character. I think all precipitation advocates are very much in the habit of attributing to their particular chemical, or whatever they put in, which is really an infinitesimal portion, a value which I attribute to the mode of treatment in the tanks. The natural tendency of gravitation causes the thick part of sewage to settle, and by having tanks of sufficient length you are enabled by this simply to take out the greater part of the impurities—the solid part of sewage. There is also a great deal done in the way of arresting the floating matter—the grease and fæcal matter, which float on the top of sewage, and which as a rule are the most offensive. All that kind of work—the skimming

off of disagreeable and offensive matter, in all precipitation works, is done in the background. They do not bring this sort of thing forward, but it is done somehow or the other, otherwise the tanks would look horrible. Nothing is said about this, just as nothing was said about sewage sludge in the early days of sewage irrigation. All the great authorities who swore by irrigation told you nothing about the necessity of taking the sludge out, and made no account of the great difficulty in dealing with the sludge. In the same way this skimming off of the floating matter on sewage is never brought prominently forward, but of course these matters are reckoned as impurities in the sewage to begin with, and the chemicals get the credit of removing what is really skimmed off mechanically. I will now pass to the comments on my paper by Mr. Vawser and other gentlemen, who have I think seen the drift of it, which was designedly rather vague, with the view of eliciting discussion. These gentlemen have drawn the very conclusion I desired—that we should have free trade in sewage. Hitherto we have not exactly had free trade, and you have heard one result in the account which Mr. Pritchard has given of the heavy and fruitless expense entailed on the Lower Thames Valley Drainage Board. I think that should be taken as a warning that local boards cannot afford the expense of ferreting out for themselves and going through an immense number of details necessary to be known, and of really testing practically what is the best course to be adopted in any particular place. These conditions, as has been said, are so varied that it requires some impartial person, who knows the circumstances and the details of the question. I think I have been misunderstood in my references to authoritative advice. I guarded myself against any departure from local self-government. I consider that the ratepayers, who have to provide the money, should decide what ought to be done with it. I merely considered that some suggestions might be formulated—they would be difficult to draw up—which might be generally useful, and that facilities should be afforded for an impartial opinion, by which local authorities should not be bound, but having obtained it for their guidance, should then be at liberty to adopt it or leave it, as they liked. I think I have been rather misunderstood, as if I had suggested that the central authority should take the responsibility out of the hands of the local authority—a thing I particularly guarded myself against in my paper. I desire that there should be the utmost free trade in

sewage, only I think, as a matter of economy for ratepayers generally throughout the country, there should be some facility for them to secure themselves by obtaining advice which would have more weight than the opinions of their own members, who are very often governed by local prejudices and interests.

A vote of thanks was unanimously accorded to Col. Jones for his interesting paper.

STEAM TRAMWAYS.

By JAMES HALL, Borough Surveyor, Stockton.

The value of tramways cannot better be appreciated than by the fact that the whole of the principal towns and cities have adopted them; and the writer ventures to state that under no circumstance would the boon be dispensed with. In these times, when everyone is working at high pressure, a quick and cheap means of transit is indispensable. Up to within the past few years the cars were drawn either by horses or mules. The peculiar nature of the work renders it impossible to prevent great suffering to the animals employed, however careful and humane those in charge of them may be. The life of a tramway horse is known to be but short, consequently the working expenses are very heavy. Engineers have given the subject of a mechanical motor their most careful attention; and now we have placed before us several engines constructed to work our trams. The Board of Trade imposes several restrictions, to ensure as much as possible the safety and convenience of the public.

It is to be regretted that the inventions of English engineers should have received so little support from the English authorities, and it is something akin to disgrace that Newcastle, the birthplace of the locomotive, should decline to use steam power upon their tramways. It may be truly said that an inventor hath honour save in his own city.

In looking over the record of the various bills and provisional orders before Parliament and the Board of Trade this year, the writer is pleased to see that, in nearly every application, powers are sought to use steam.

The regulations of and the conditions imposed by the Board of Trade are of such a reasonable nature that no one can possibly find any objection to them, they being framed for the protection of the public and the safety of the passengers. The chief conditions may be briefly summarised as follows:—There must be no *visible* smoke or steam; no visible fire; and the working machinery must be out of view, and so contrived as to cause no noise calculated to frighten

horses or annoy the public; the engine must be so constructed that the driver is always stationed at the front, and he must have absolute control over the engine and brake; the latter must be of the most sure and powerful description, so that almost instant stoppage can be effected; the engines as well as the cars should be short coupled, to facilitate the turning of sharp curves with safety; all wheels should be properly guarded, and automatic speed regulators provided.

In Stockton the tramway system is worked entirely by steam power, and no accidents of any serious moment have ever occurred. The writer is most decided in his opinion that steam is a much safer means of transit than animal power, and, without any doubt, much more economical. The length of tramways in Stockton at present is upwards of 4½ miles. Powers have been recently obtained to extend the system. Eight engines are used, and nine cars; the general dimensions of the engines are as follows:—

Six 7-in. cylinders and 11-in. stroke.
Two 7½-in. „ and 12-in. „

The following statement (pp. 282, 283), extracted from the *Engineer*, June 29, 1883, may be of some interest to you.

Generally speaking, Stockton may be considered a town peculiarly suited for tramways, on account of the width and level of its principal streets. Although for a short distance—and that really outside the town—the gradient is 1 in 18, generally the gradients do not exceed 1 in 50. The line is a single one, with passing places so arranged that the driver can always see two passing places in front, the point at the passing places being so arranged that a collision is impossible.

The writer has seen the engines made by Messrs. R. & W. Hawthorn, Newcastle, Messrs. Black, Hawthorn, & Co., Gateshead, and Messrs. Kitson of Leeds, and that patented by Mr. Wm. Wilkinson, but cannot claim to have any personal knowledge as to their working. No doubt, some gentlemen present will be able to give some valuable information with reference to the engines running in their towns.

There is one nuisance in steam trams which has not yet been overcome; that is the stythe emitted from the funnel of the engine. This, however, can very easily be remedied by placing wood and glass screens at each end of the car.

To speak of the advantages of tramways, either in urban or rural

"The Running Expenses of

"We have received the annexed copy of the last half-yearly running and repairs manager, Mr. Robert Sutehall. This statement, it will be seen, gives an average apparently just about half the running cost of engines with vertical boilers on this line have now been in use for eighteen months, the figures given are depends upon the working of the engines used. The engines were supplied by

The Stockton and Darlington Steam Tramway Company, of Engines for Six Months, from

For Week ending	Wages.			Repairs and Renewals.			Coke—quantity.						Coal—quantity.					
1882:	£	s.	d.	£	s.	d.	tns.	c.	qrs.	£	s.	d.	tns.	c.	qrs.	£	s.	d.
December 4	10	15	0	3	4	0	7	17	2	5	15	6	0	7	0	0	4	8
„ 11	10	15	0	2	16	10	7	17	2	5	15	6	0	7	0	0	4	8
„ 18	10	15	0	3	3	2	7	17	2	5	15	6	0	7	0	0	4	8
„ 25	10	15	0	8	17	2	7	17	2	5	15	6	0	7	0	0	4	8
1883:																		
January 1	10	15	0	16	19	10	8	6	2	6	2	1	0	7	0	0	4	8
„ 8	10	10	0	2	19	2	7	17	2	5	14	2	0	7	0	0	4	8
„ 15	10	15	0	2	4	10	7	17	2	5	14	2	0	7	0	0	4	8
„ 22	10	15	0	2	4	5	7	17	2	5	14	2	0	7	0	0	4	8
„ 29	10	15	0	2	15	5	7	17	2	5	14	2	0	7	0	0	4	8
February 5	10	15	0	3	12	4	7	13	0	5	11	0	0	7	0	0	4	8
„ 12	10	15	0	2	16	9	7	13	0	5	11	0	0	7	0	0	4	8
„ 18	9	4	2	13	1	1	6	15	0	4	17	10	0	6	0	0	4	0
„ 25	10	15	0	1	10	1	7	17	2	5	14	2	0	7	0	0	4	8
March 4	10	15	0	2	0	2	7	17	2	5	14	2	0	7	0	0	4	8
„ 11	8	2	6	0	17	10	5	0	0	3	12	6	0	5	0	0	3	4
„ 18	10	15	0	2	4	5	7	17	2	5	14	2	0	7	0	0	4	8
„ 25	10	14	2	2	6	6	7	7	0	5	6	7	0	7	0	0	4	8
April 1	10	15	10	1	5	3	8	6	2	6	0	8	0	7	0	0	4	8
„ 8	10	15	0	1	14	11	7	13	0	5	11	0	0	7	0	0	4	8
„ 15	10	15	0	8	1	10	7	17	2	5	14	2	0	7	0	0	4	8
„ 22	10	15	0	7	8	8	7	17	2	5	14	2	0	7	0	0	4	8
„ 29	10	15	0	7	18	8	7	13	0	5	11	0	0	7	0	0	4	8
May 6	10	10	0	6	19	9	7	13	0	5	11	0	0	7	0	0	4	8
„ 13	10	5	0	3	16	6	7	17	2	5	14	2	0	7	0	0	4	8
„ 20	10	8	4	4	2	2	8	6	2	6	1	0	0	7	0	0	4	8
„ 27	10	15	0	5	5	3	7	17	2	5	14	2	0	7	0	0	4	8
June 3	10	15	0	1	12	7	7	17	2	5	14	2	0	7	0	0	4	8

Average cost per mile per engine, 2·86*d.* + ·26 = 3·12*d.*

"The recently issued half-yearly statement of working expenses of the Stockton engines employed are working the lines at an average cost of 3·12*d.* per mile per engines have been in use over eighteen months:—Average wages per week for 27 coke (7 tons 14 cwt. 1 qr. 7 lb.), £5 12*s.* 1·3*d.*; coal (6 cwt. 3 qrs. 15 lb.), 4*s.* 7·11*d.*; Water and preparing coke (per mile), ·26. Average number of miles run—

Tramway Locomotives.

account of the Stockton and Darlington Steam Tramways, prepared by the expenditure per engine of 3·12*d.* per mile, six engines being employed— recently introduced, and of which so much has been said. As the machines of considerable value, as the financial success of a steam tramway manifestly Messrs. Merryweather & Sons, London.

Limited, Stockton-on-Tees.—Cost of Repairs and Running December 4th, 1882, to June 3rd, 1883.

Oil—quantity.				Waste—quantity.				Total.			Miles run.	Cost per Mile.			Water, &c.—Preparing Coke.		
½-pts.	£	*s.*	*d.*	lb.	£	*s.*	*d.*	£	*s.*	*d.*		£	*s.*	*d.*	£	*s.*	*d.*
117½	1	0	2	15	0	3	0	21	2	4	1905½	0	0	2·66	0	0	·26
118½	1	0	4	15	0	3	0	20	15	4	1768	0	0	2·81	0	0	·28
118½	1	2	0	15	0	3	0	21	3	4	1915½	0	0	2·65	0	0	·26
116	1	1	6	15	0	3	0	26	16	10	1790½	0	0	3·59	0	0	·28
125½	1	3	3	15	0	3	0	35	7	10	1935½	0	0	4·38	0	0	·26
118½	1	2	0	15	0	3	0	20	13	0	1890½	0	0	2·62	0	0	·26
120½	1	0	9	15	0	3	0	20	2	5	1920½	0	0	2·51	0	0	·26
118½	1	0	4	15	0	3	0	20	1	7	1930½	0	0	2·49	0	0	·26
118½	1	0	4	15	0	3	0	20	12	7	1920½	0	0	2·57	0	0	·26
115	0	19	9	15	0	3	0	21	5	9	1835½	0	0	2·78	0	0	·26
115	0	19	9	15	0	3	0	20	10	2	1885½	0	0	2·61	0	0	·26
102	0	17	6	15	0	3	0	28	17	7	1635½	0	0	4·16	0	0	·30
118½	1	0	5	15	0	3	0	19	7	4	1925½	0	0	2·41	0	0	·26
120½	1	0	9	15	0	3	0	19	17	9	1925½	0	0	2·47	0	0	·26
75½	0	13	0	15	0	3	0	13	12	2	936½	0	0	3·48	0	0	·34
118½	1	0	5	15	0	3	0	20	1	8	1871	0	0	2·70	0	0	·26
111	0	19	1	15	0	3	0	19	14	0	1785½	0	0	2·64	0	0	·28
127½	1	1	11	15	0	3	0	19	11	4	1995½	0	0	2·35	0	0	·25
117	1	0	2	15	0	3	0	19	8	9	1890½	0	0	2·46	0	0	·26
122½	1	1	0	15	0	3	0	25	19	8	1920½	0	0	3·24	0	0	·26
123½	1	1	2	15	0	3	0	25	6	8	1910½	0	0	3·18	0	0	·26
116	0	19	11	15	0	3	0	25	12	3	1890½	0	0	3·25	0	0	·26
117	1	0	1	15	0	3	0	24	8	6	1890½	0	0	3·10	0	0	·26
118½	1	0	5	15	0	3	0	21	3	9	1890½	0	0	2·69	0	0	·26
125½	1	1	7	15	0	3	0	22	0	9	1976	0	0	2·67	0	0	·25
119½	1	0	6	15	0	3	0	23	2	7	1900½	0	0	2·92	0	0	·26
118½	1	0	4	15	0	3	0	19	9	9	1930½	0	0	2·42	0	0	·26
							Total ..	£595	15	8	49,973	..			0	0	7·18

and Darlington Steam Tramways Company states that the six Merryweather engine. This average is obtained as follows from the following figures, as the weeks on six engines, £10 10*s.* 11·11*d.*; average repairs and renewals, £4 10*s.* 4·20*d.*; oil (113 half-pints), £1 0*s.* 3·74*d.*; cotton waste (15 lb.,) 3*s.*—£22 1*s.* 3·86*d.* 1850·85. Average cost per mile per engine, 2·86 + ·26 = 3·12*d.*"

districts, would be outside the scope of this paper; but the writer ventures to state that few schemes for social benefit or improvement have been more beneficial than the adoption of the tramway system.

The writer would suggest that all tramway companies should endeavour to fix certain stopping places, so that the trams will not be stopped at unreasonable distances, which is too often the case. There are some inconsiderate people who insist to be let down at the very door they wish to be at, although probably the car may have been stopped only a few yards from their destination. Such conduct is both irritating to the other passengers and the officials, and no wonder that the latter are not so courteous as they otherwise would be. A lamp with a distinguishing colour by night and a direction board by day, stating that that was a stopping place, would very soon overcome the difficulty, and add to the more punctual running of the trams. The writer sincerely trusts that this suggestion may be carefully considered by the authorities and proprietors of tramways.

The writer must apologise for not having treated this subject in a more perfect manner, but various circumstances have prevented the same from being done; but if a practical discussion upon "Steam on Trams" be elicited, the writer's object is served.

DISCUSSION.

Mr. Pritchard: I would venture to say that the apology in the last paragraph of Mr. Hall's paper is quite unnecessary, because he has given us some very valuable information. Not very long since, Mr. Vawser, who has had considerable experience, also gave us much valuable information respecting tramways. I am pleased to see both Mr. Vawser and Mr. Spencer here, and I hope they will give us their views on this subject. I will also venture to offer a few remarks, because I too am largely connected with steam traction on tramways. I will just take seriatim the points to which I wish to draw attention. Mr. Hall suggests that the whole of the principal towns and cities have adopted steam. Well, I hope that will soon be the case, but we can scarcely say that it is so at present, when we look at such places as London, Liverpool, Manchester, and Newcastle.

Mr. Hall: I did not say that they had adopted steam, but have adopted the system of tramways.

Mr. PRITCHARD: I hope they will soon also adopt steam. In Manchester, although there are very long lengths of tramways, I believe it is a fact that not a single steam tram-engine is allowed in Manchester.

Mr. FOWLER: That is so.

Mr. PRITCHARD: And yet there are 140 miles of tramways in Manchester. In Liverpool also, where there are nearly 100 miles of tramways, up to the present time no steam-engine is allowed to run. At Bristol they have tried steam, and—this is a most unfortunate feature—they have abondoned it and gone back to horses. They got a licence for six months, and used an engine, but not one of modern make, and they had the horses, gearing, and cars, which would have to be sold or altered, and so—"Oh, no, no! the engine is not satisfactory!" Bristol is consequently without steam on its tramways. Then there is Newcastle, the place where the steam-engine was originated—the one place best suited of all others for steam-engines on tramways. Yet there is nothing of the kind here in Newcastle. The same remark also applies to Birmingham, which seems to have been one of the last of the large towns to take advantage of tramways. For many years, what tramways they had there had grooves so wide that the wheels of gentlemen's carriages were in danger of being wrenched off, and people riding on them ran the risk of being injured. But a change has come over the scene, for although there were only some seven miles of tramway eighteen months or two years ago, a line with which I am connected, the Birmingham and Aston Tramway, is now being worked by steam; and some forty additional miles of road have been especially constructed to be worked by steam, the gradients in some instances being very severe. Now, in Birmingham, we are following the example of the districts where steam has been in operation some time. Everyone will agree that, merely from a humane point of view, it would be a great advantage to substitute steam for horses on tramways. A tramway horse works very easily on the level, where the car runs with very small frictional resistance, but directly he has got to raise a dead weight—on some hills almost a perpendicular lift—he is very soon worn out. Therefore on the ground of humanity, I should consider it a great gain to substitute steam for horses. Reference has been made to the Orders of the Board of Trade. I think you will all agree with me that General Hutchinson has met, in every possible way, as far as was consistent with the safety and accommodation of the public, the requirements

of the various companies; and to my mind, the restrictions of the Board of Trade are not severe. They are, I think, very proper restrictions. Only a short time since we had a meeting of tramway engineers in London, to which we invited General Hutchinson. He attended the conference, which discussed the best construction of engines and cars, speed, the safety of passengers, and other matters. The great objection to the use of steam comes from local authorities. The Board of Trade has issued very fair regulations, with which I think we ought to be perfectly satisfied. Now we come to the point of no visible smoke or steam. That I think is now altered, and it is that it shall not be "to the annoyance of passengers." This alteration has been made by the Board of Trade at the request of tramway authorities. It was before "that no visible smoke or steam should be issued to the annoyance of the public." This led to many summonses being taken out by persons who were not passengers at all by the tramcars. Even when coke is used there must be some products of combustion; but this has been got rid of on the Birmingham and South Staffordshire tramway by having canopied cars. There are two things I should like Mr. Hall to give us—what the pressure of the steam in the boilers is, and also the length of the gradients. This is a very exceptional working expenditure which he quotes; I do not know that I have ever heard of any similar road where the expenses have been so low. There is a gradient of 1 in 18 for a short distance, but generally they do not exceed 1 in 50 on this line; gentlemen present will agree with me that these are exceptionally good gradients. I have on the Stourbridge and Dudley line a 400 feet rise in 4 miles, and I have a gradient nearly half a mile in length of 1 in 15. The engines have to be proportionately heavier, the steam pressure is greater, and the cylinders proportionately larger. Just a word as to the details of expenses at Stockton. We have wages, repairs and renewals, coke, coal, oil and waste, and also the water and preparing the coke. In fact, there appears to be every expenditure enumerated, excepting, I do not know whether stores are included, and also depreciation. Anyone dealing with the satisfactory working of tramways always considers that very heavy item of depreciation. On the steam tramways on which I am engaged, so far I have always supported a very heavy figure for depreciation. It really means the renewal of an engine in about six years, representing yearly about one-sixth of its annual value. That is about what we have generally adopted.

Now the renewals of engines and repairs are paid out of revenue, but no statement of what they cost is here given. I think it is very desirable that we should know the cost of their engines. The cost of the Kitson engine on the Birmingham and Aston line, during the seven months ending the 31st January, 1884, had been for 98,700 miles:—Wages, 1·4*d.*; fuel, ·96*d.*; oil, &c., ·22*d.*; water, ·11*d.*; stores, &c., ·21*d.*; repairs, ·80*d.*; depreciation, 1·43*d.* This gives a total of 5·13*d.* per mile run. You will perceive that the highest item is depreciation, and deducting that from the total we get 3·70*d.* per mile run. I thought this was an example of exceptionally low cost of working a tramway, but the figures given by Mr. Hall are even more favourable. There are, however, the points of the gradients, and also the weight of the traffic. The traffic on the Birmingham and Aston line is exceptionally heavy, and it is no uncommon thing to convey 12,000 people in one day. The gradients also are somewhat severe, there being a gradient of 1 in 20 for a considerable length, probably nearly half a mile. Then there are two or three gradients even more severe than this. The ruling gradient is, I think, 1 in 14, but only for a short length; you will perceive that this necessarily has something to do with the cost of working a tramway. We have also the Wilkinson type of engine, which a few years ago created considerable sensation. It was entirely contrary to the ordinary kind of tram-engines and their construction, inasmuch as what was called superheated steam was used, and it was said to be decomposed. That we know is a mistake, as the steam is simply emitted at a high degree of temperature, and is not visible. Where the steam is all given off, the water is not taken back again to the boilers, and there is consequently a much greater expenditure for fuel and water. There is another point worthy of consideration referred to by the author of the paper—the method of turning sharp curves. It requires a short wheel base for that. Consequently the Kitson or Merryweather engine can pass a curve with less frictional resistance than the Wilkinson engine. I think the wheel base is 4·6 feet in these condensing engines, as compared with 5·6 and 5·9 on the Wilkinson engine. That brings me to another point, on which I had hoped to submit some results obtained by Mr. Grover. In contending that some kind of flexible wheel base is desirable, he is perfectly right. For instance a car with a fixed wheel base not only creates greater frictional resistance, but is also a source of danger. I think we may fairly attribute the accident at Blackburn,

and also the one at Blackburn and Huddersfield, to the fact of the cars having fixed wheel bases, as the slightest jerk will throw them out of the groove. It is very significant that there has never been an accident from the turning over of carriages with bogie frames, where there is no pitching movement. The Board of Trade are evidently of the same opinion, because they have given a general intimation to tramway engineers, that all cars which are to be drawn by steam power, if they are to carry passengers outside, must have flexible bases. I have made some experiments as to resistance on the Birmingham and Aston line, where they have two kinds of cars and two kinds of engines. One has the ordinary wheel base 5 to 9, and 3 feet 6 inches gauge of line, and the other is a long car, with two four-wheeled bogey frames. One weighs 2 tons, and the other 4 tons. The engines running these cars are the same. I had an experiment made to test the amount of resistance to the road upon curves. I did not make this test with the dynamometer—which you may perhaps say I should have done—but by the expenditure of fuel. In the morning the small cars were run with the minimum number of passengers, and in the evening the larger cars with the maximum number of passengers —the former 40 the latter 62. Although 100 per cent. greater weight, and carrying 50 per cent. more passengers, the consumption of fuel represented rather under 10 per cent. for the larger cars in excess of what was used for the smaller ones. That is a strong point, the saving of fuel and consequent decrease of working expenses, and it has been proved these cars are a distinct source of safety in the conveyance of the public. The suggestion made by Mr. Hall, that there should be regular stopping-places for cars, is a most important matter. I think it would be well if the Members of this Association were to insist in their respective towns that there should be tramway stations. This practice is most successfully carried out in Liverpool, where there are coloured lamps, marked "Tramway Station," and the tramway cars stop at these stations to take up and set down passengers, and nowhere else besides. I do not know whether this could be done without the approval of the local authority through whose streets a tramway is laid. I believe when power is given by a local authority to lay the tramway through the streets of a town, the company is required to stop their cars at any point where passengers wish to get up or to alight. I think Mr. Hall's paper will have the effect of ventilating this question, which is becoming intimately connected with the duties of municipal engineers and surveyors.

Mr. Spencer: Mr. Pritchard has treated this subject in such an exhaustive manner that he has left anyone following him very little to say. The Board of Trade regulations, as has already been said by Mr. Pritchard and the author of the paper, are very reasonable. At the same time there is one point which requires the attention of engineers, and also of the Board of Trade, and that is as to the nature of the governor. So far as I know, no governor has yet been invented which carries out the requirements of the Board of Trade. Therefore, practically, the Board of Trade requires a tramway company to do what at present is simply impossible. It is very easy for the Board of Trade to say an engine should have a governor to put on the brakes automatically when the engine attains a certain speed named. There is such a brake, which works for a few days, and then has to be removed to be repaired. Perhaps it would be better if the Board of Trade, before imposing such a restriction, would find such a governor as they require. When these governors are set at 9 miles and not exceeding 10 miles an hour, the engines whilst going at that speed are constantly being stopped. The governor then, when the speed has been checked, itself releases the wheels, and the engine goes on again. You have to depend wholly upon this governor when the engine-driver does not happen to be upon the engine, as was recently the case at Wigan, and yet, from the nature of its action, there is the liability to a series of collisions under such circumstances. That is to say, the governor, when the engine attained the maximum speed, would act and bring it to a stand, and then release the wheels, when the engine would go on again until it was again checked. It would be much better to have a governor which would put on the brakes, and stop the engine permanently, until started again by the driver. The serious difficulty of the slipping of the wheels in going uphill has been overcome by the adoption of a fifth wheel; but it must be known to the Board of Trade that a great number of engines are constructed without any fifth wheel. I think, in making their restrictions, the Board of Trade should take into consideration that in many cases it is impossible to have a fifth wheel. In such cases, when the wheels slip in going up hill in wet weather, the nominal speed of the engine gets beyond the 10 mile limit whilst the engine and car are practically making no progress at all. But still the governor acts, puts on the brakes and brings the engine to a standstill, when actually it is not going up the hill at the rate of a quarter of a mile

an hour. Mr. Hall has given a little rub to the eminent city in which we are now discussing his paper. He regrets that, in the town where the steam-engine had its birth, or rather development, steam tramways seem to be prohibited. No doubt the authorities of Newcastle have a great many sins to answer for, and perhaps we think them more numerous than gentlemen from a distance do; but I trust I may be allowed to say that it is not the Local Authority which should be blamed for the inadequate mode of propelling tramcars. The manager of the Stockton Tramways has prepared a very useful and interesting table of expenses, and it must be a matter of surprise to everyone who has seen it that the line is worked at such a small cost, and especially that so small a quantity of coke is used. So far as I can judge, it averages from 10 to 12 lb. per mile run. Contrasting this with the Wilkinson engine, I may go so far as to say that it is abnormally small. As Mr. Pritchard has stated, there are a great many extraneous circumstances which go to make up the difference of the consumption of fuel. That is to say, with a Wilkinson engine suspended on blocks, a given number of pounds of coke would produce a certain number of revolutions of the wheels; but with the Merryweather engine no doubt there would be a difference. The Stockton tramway is a very easy line, there are very few gradients indeed, and it is on these long lengths of level line that these favourable results are attained, not only in the consumption of coke, but also of the other necessary concomitants requisite for steam traction. The Wilkinson engine has been found, under various circumstances, to use from 18 to 20 lb. per mile run, and with extremely heavy carriages as much as 22 to 25 lb. per mile. That is what we may call an enormous consumption; and certainly any advantages which may be found in the Wilkinson engine are counterbalanced by the great cost of fuel. With regard to steam, it was a little pleasing fallacy to say that the steam which was not used would be decomposed. Engineers know very well that this is not the case; the steam is visible, but there is no vapour. The heat is also frequently felt in the streets, and Mr. Hall seems to think the smell from the funnel should be obviated. There is another thing equally detrimental and objectionable, and that is the smell of the heated oil. You may frequently observe a horse going along a street, with a car between it and the engine. It does not know that the engine is there, and yet before it gets within fifty yards of it, up goes its head, and it expands its nostrils, and it is evident that the

smell of the engine is much more objectionable to the horse than the sight of the engine itself would be. The smell from the oil is, I fear, a nuisance that it would be very difficult to get rid of, and with which we shall for the present have to put up. As to having stopping places for tramcars, that has frequently been adopted in France, and to-day I have heard for the first time that it is being practised in Liverpool. It may answer in large towns, where the population is large and the traffic heavy, where the people must ride and will go to some inconvenience to get on the tram; but in smaller towns, where all traffic has to be encouraged, I am afraid such a system could scarcely be adopted with advantage to the companies, because it is only by taking people up just where they wish, and setting them down where they desire, that, in many small lengths of tramway, passengers will ride at all. It is only by these conveniences that tramways are able to compete with suburban railways, but if you make people walk some distance to a tramway station, I fear they would then prefer the railway. The total cost of working the Stockton tramway, 3·12*d.*, as given in Mr. Hall's paper, is certainly very small, and I think we may assume that no amount whatever has been allowed for depreciation. With the Wilkinson engine the cost is excessive; at any rate within my own knowledge it has been equal to 5*d.* per mile. I admit in that case the gradients were somewhat heavy. We may take it that the large consumption of coke to which Mr. Pritchard has alluded has something to do with that. I am very much surprised to hear the statistics which Mr. Pritchard has given us with regard to the wheel base. Certainly the bogey-wheel base will go round a curve easier than a fixed one; but you must remember, when running on the straight, the friction of the four fixed wheels must be considerably less than the bogey. The bogey base has eight wheels of smaller diameter, and consequently there must be greater friction on the rails, and must on the straight put greater stress on the engine than the fixed wheel base, which runs smoothly and glibly along, even, I think, when going round a curve. This, however, is perhaps a point on which there may be difference of opinion. Though I adopt Mr. Pritchard's figures as correct, I am surprised the consumption of fuel and the cost of the engines drawing the larger cars was actually less.

Mr. Pritchard: No; one-tenth in excess.

Mr. Spencer: I think we can all agree heartily with Mr. Hall as to the advisability of substituting steam for horses in working

tramways. I have very little doubt local authorities will soon become more favourable to steam; and that in time even this city will remove the stigma which Mr. Hall, perhaps from a little incorrect information, has cast upon it.

Mr. Platt: I agree with Mr. Spencer's remarks respecting fixed tramway stations. I do not think such a system would be found practicable with ordinary tramways. The great feature of tramways is the facility with which passengers can get on and off them compared with railways. In the town I represent considerable expense has been gone to in working steam tramways. In fact, tramways could not possibly be worked in Rochdale except by steam, owing to the very heavy gradients. As a natural result, a considerable amount of experience has been gained as to the style of engines suitable for such heavy gradients. The line is known as the Manchester, Bury, and Rochdale Tramway, and Mr. Vawser is one of the engineers. Having to inspect the engines and cars, and see that the Board of Trade regulations are carried out, I have had some experience of their working. We have gradients of 1 in 15 and 1 in 20 over considerable lengths. The line was furnished principally with Wilkinson engines—not all of Wilkinson's make, but Wilkinson's patent. The result is that at least half-a-dozen of the first engines have had to be abandoned, because they were not able to ascend the gradients. It became quite a common thing to see the wheels of the engine whirring round, whilst the engine was actually going back. This has been obviated by substituting heavier engines, with larger cylinders. Something has been said about self-acting governors. That is a point to which I have paid great attention, and I agree that no governor has yet been in general use which is satisfactory. It is only due to the locomotive superintendent of the Manchester, Bury, and Rochdale line (Mr. Newill), to say that he has brought out a governor of his own invention, which I believe will answer. The fifth wheel has been given up as worse than useless, because it contributed in a great measure to the breach of the regulations as to noise, especially if the line was a little uneven or the governor ineffective. Reference was made to Mr. Grover's car. This tramway was first equipped solely with Mr. Grover's cars, which were fairly successful, but my objection to them is the complication underneath.

Mr. Pritchard: I did not recommend them.

Mr. Platt: We had no accident from turning over, although there are curves with 20 feet radius. The great drawback to these

cars, in my mind, is the complication underneath, where there are so many bars and levers which require attention. We have lately had some of the Pullman cars, made by the Falcon Co., and they seem to run very smoothly indeed. A peculiar circumstance happened soon after they were introduced: the front wheels of one of the cars left the line and went square across; but generally speaking they run very smooth, and take the curves well. I saw in the 'Engineer' the expenses of the Stockton line as quoted by Mr. Hall; I thought at the time they were exceedingly low, and I know that our loco. superintendent cannot get down the working expenses to anything like that point.

Mr. Vawser: I am very pleased to hear that Mr. Hall has a good word to say for steam tramways: so many complaints reach the public press, and these complaints assume so many varieties of inaccuracy, that it is very cheering to those who are in any way associated with steam tramways to hear the Borough Surveyor of Stockton say a word in their favour, more especially as we know that his experience is not of a cursory nature, but is the result of daily and every day observation during the last two or three years. I will not venture to question the accuracy of the interesting statistics Mr. Hall has given, and shall be glad to believe they are correct, but in some particulars they do not correspond with my own experience, and the fact that these figures are put forward by the makers of the engines working on the Stockton lines and not by the tramway company, may have some bearing on the question. I should have had more confidence if these figures had been the result of the company's experience, and were issued by the authority of the company. My own observations show that the working cost of steam tramways is from 4*d.* to 6*d.* per mile, according to local and atmospheric conditions, but this is upon roads very different to those at Stockton; in many places the gradients are as steep as 1 in 15, and hardly a level piece of road can be found, whereas at Stockton we are told the ruling gradients are about 1 in 50, and the steepest piece of road is not much worse. With conditions so unlike, the results can hardly be similar, but if the figures quoted in the paper are correct, the result is highly satisfactory, and reflects great credit on the eminent firm who supply the engines, and who are known to produce a class of work not easily excelled. Complaints of noise, smoke, and steam from tramway engines are not altogether unfounded, but are often unnecessarily exaggerated. Steam and smoke are prohibited by the Board of

Trade regulations, and any engine which systematically offends would be unsuitable for town purposes. Sometimes smoke and steam are emitted through the carelessness of the attendant, and sometimes through atmospheric causes, in which case it is unavoidable. I recently saw large volumes of steam emitted in the principal streets of Huddersfield, where the tramways are worked by the Corporation, and where I am sure every care is taken to avoid cause of serious complaint, and I could not avoid thinking that if the same indulgence that is allowed the Corporation were extended to companies elsewhere who are striving to introduce improvements—as much for the benefit of the public as for their own shareholders—far less complaints would be heard. It is no secret that noise, smoke, and steam are constantly found in many of the leading streets of most manufacturing towns, and no one complains, but when a steam tram engine offends in a very slight degree it is at once an object of universal censure. I am not biassed in favour of any engine, and do not know that I have even a preference for any one; all appear to have some special point of advantage, and all have some fatal defect. I do not think any of us have seen the tramway engine of the future, and when we next meet in Newcastle the tramway engines of to-day will probably be obsolete. It is not easy to foresee what direction the next change will assume. Few will deny that the adoption of steam in lieu of horse traction has wrought a great improvement, and given a great impetus to tramway enterprise, but nothing I think to be compared with the changes in the near future; steam traction has rendered a tramway practicable and remunerative in comparatively scattered districts, and upon gradients altogether impracticable for horses, and I think we shall some day see our main roads occupied with a network of tramways, not in opposition to railways, but in connection with and feeding them. Tramways are particularly adapted for local traffic, and will convey passengers and goods to their destination, while railways are better adapted for long journey traffic. A question has been raised as to the necessity for the double bogey, or the six-wheel flexible wheel base for tramcars; on fairly straight horse tramways, with easy gradients and with cars carrying about 40 passengers, either of these systems, or even the ordinary four-wheeled car, may be used with safety, but with steep gradients and sharp curves tramcars are manifestly unsafe unless supported near their ends, and the danger is greatly increased with steam traction, where the cars are sometimes jerked rather more

sharply than by horses. All the serious accidents that have occurred have been with the four-wheeled cars, which have a dangerous overhang at both ends, and as no accident has occurred where the double bogey has been applied, some justification exists for the assertion that the fatal accidents at Huddersfield and Birkenhead could not have happened with the double bogey. The flexible wheel base is designed to allow the car to travel round a circle of comparatively small radius, but it ceases to work to advantage when the leading and trailing wheels are on different curves, or when one is on a straight line and the other on a curve; in practice, therefore, the principle fails every time the car enters a curve, and where there are frequent curves the system has no practical advantage. This wheel base has been used in Lancashire, but has not given full satisfaction; the double bogey, on the other hand, appears to answer all requirements, and is coming rapidly into favour. A short description of a flexible wheel base, which as a mechanical contrivance is very ingenious, will be found in the present volume, page 42. Fixed stopping places have been adopted in some districts in Liverpool, they are usually arranged at the foot and summit of a steep hill; the tramways are worked by horses, and as the gradients are rather steep it is exceedingly difficult to start a load on an incline. The arrangement is satisfactory to the public and no complaints are made; the stopping places are indicated by coloured lamps, and a printed board informs intending passengers that all tramcars stop at that point.

Mr. Eayrs: I am sure the paper that has been read opens to us a wide field for discussion. From the large number of Provisional Orders that have been applied for, it shows that steam is gaining favour very much with the public of this country. It must not be assumed, however, that the introduction of steam entirely depends on the interference with the ordinary horse traffic, but the authorities must also be careful before adopting the steam tram in preference to horse traction that the construction of the lines is strong enough to bear the extra strain put upon them by the introduction of the steam-engine, when their tramways are in many instances only suitable for horse traction. There is no doubt in my mind that the girder rail system is the best for steam traffic which has been introduced, but we find that owing to the absence of elasticity in the girders, there is a great deal of noise, and a greater strain on the engines. With regard to the rules of the Board of Trade, there is no doubt they are very reasonable. They say that you ought to have governors on steam

trams. Whenever I have inspected them I have nearly always found them out of order. I have found very great difficulty in getting the men to keep them acting, and we have complaints repeatedly to the same effect. I would suggest that the Board of Trade should appoint inspectors to see that their rules are carried out, and that the country be divided into suitable districts for this purpose. As to the Wilkinson engine—they are made both by Messrs. Wilkinson, B. Peacock, and others. In spite of all they can do, they are still a great annoyance to people who have carriages drawn by restive horses, but this will gradually die out. The stithe is another nuisance. I think the remedy for that is to provide a wooden or glass screen at the end of the car, which would prevent the passengers on the roof from being annoyed by the fumes emitted from the funnel. This arrangement would only protect the passengers themselves, however, the people living along the route would still suffer from these noxious fumes entering their dwelling houses and business premises. The public should be protected in this matter. Mr. Pritchard told us yesterday that in his opinion the rule which reads, "That steam should not be emitted so as to cause any annoyance to the *public*," should be altered so that the word *public* would read *passengers*. This is not fair. If we give up our roads, and cause them to be monopolised by tramway companies, we have a right to be protected from the nuisance caused by the emission of steam and other noxious fumes. With regard to engines generally, we have some of the same type as those used in Rochdale. These engines can pull a 20-foot bogey car, fitted inside and out, up a gradient of 1 in 16 on the curve. Some of the engines in use at the present day would be quite unable to do this, whereas our 5-ton or 5½-ton engines pull passengers up this gradient quite easily. The long bogey cars described by Mr. Vawser are very convenient. The only objection to them is that they are too narrow. When the Provisional Order was applied for for West Bromwich, we wanted the cars six inches wider than they are generally constructed, as, without the addition of this six inches in width the public find it very inconvenient passing up and down the centre of the car. Some of our cars are constructed with iron frames, and others of wood. I think the wooden frames are greatly preferable, as the iron ones make more noise and jarring, whereas those made of wood are more elastic, and there is consequently not so much rattling.

I find that in my district, after the steam trams had been running a few months, the horses got quite accustomed to them. It is now the exception to see the horses shy, instead of the rule. You will frequently see horse-breakers training young horses to the use of steam. Referring to the question of stopping places; this question is a very important one. There should be certain points, which are most convenient to the public, fixed for the trams to stop at, to take up or set down passengers, and at these places there should be labels on the lamps calling attention to the stopping places. The public soon get used to the system, and they go to the fixed places, knowing that the trams will stop at them; at the same time this should not prevent the cars being stopped where required to take up or set down passengers. The pulling up and starting the engines is a cause of great inconvenience both to drivers and conductors of cars, but as the tramways are laid for the public they should have the first consideration. I am of opinion that steam should be introduced in place of horse-power. It is a great strain on the horses pulling these cars, especially in starting them on gradients. I went to the Elswick Park this morning, and in going up there is a very long gradient, and I noticed it was extremely difficult for the horses to get up, to say nothing of the cruelty. Another point which, I think, comes within the scope of this discussion, is the superintendence of the construction of tramways. It is not very easy to settle where the duty of a surveyor begins and ends. Is it his duty to superintend the construction of tramways? If tramways are brought to our towns, then I say there should be extra remuneration for superintendence. As this, however, is rather outside the question of steam tramways, I should suggest that at some future meeting there might be something more said on the matter in order to secure uniformity of practice.

Mr. Fowler: As it was mentioned to-day by one of the speakers that he was astonished that Newcastle had not got steam-power on the tramways, I would like to say a few words on the matter. Now, the reason of that was owing to the very clumsy way in which steam had been introduced into Newcastle. For instance, they got an order empowering them to use steam power on the tramway from Ferham Terrace, on the North Road, to the borough boundary (there are no buildings on this route), and it was resolved to have a trial trip on this line, in which the engine had to travel over a distance of $1\frac{1}{4}$ mile in 20 minutes, at the same time taking up

another car, and work it to suit the time of the tramcar service. Whenever I inspected the governors I never found them acting, and this is one point that should have our consideration; for if the governors are not acting, of course there is a great danger of accidents. But although the Board of Trade conditions set forth terms which should be carefully attended to, still there is nobody appointed to see whether these conditions are carried out. It was partly, in my opinion, owing to the governors not acting that the accident at Huddersfield occurred. The men take off the connecting cord to the governor whenever they want to run a little faster—sometimes nine or ten miles an hour. In consequence of running steam trams on a section of the lines in Newcastle, a great strain was put upon the tramway. The road not being constructed to carry steam, it was knocked out of order, thereby causing expense to repair it. With regard to steam being generally adopted, I think large towns and villages are places where steam cannot be introduced. In large towns you cannot have the steam-engine running through the thickly populated part of the town—you cannot have the steam-engine running through the midst of the principal streets of a town like Newcastle. Whatever point of judgment we may take it from, I must say that it is not safe to run steam through thickly populated streets. In Market Street, Manchester, for instance, it would be extremely dangerous to adopt the steam-engine for drawing the cars through such a thronged thoroughfare. On one occasion while travelling in a tram in a suburban district, I asked the driver how it was that steam was not used there, to which he replied that "supposing one of the engines were to go out of order, where should we go to get it repaired?" And when you *do* get it repaired it is very costly. Also, if there are not one or two spare engines on hand—to have which means a considerable amount of capital sunk in plant—when a breakdown occurs, it simply stops the service. Therefore in large towns and in isolated villages, it won't pay to have steam. And it was mentioned yesterday, that the expenses, where steam was introduced, were no larger. Well, I think that is quite misleading. Look at the serious accidents that have happened through the cars being propelled by steam. The Huddersfield accident never would have happened if the cars had been drawn by horses. How can people say that steam is just as cheap and as safe as horse-power?

To say that it is quite as safe as horse-power is—when all contingencies are taken into account—not borne out by facts. With regard to the flexible wheel base, the best, no doubt, is the bogey. But the flexible wheel base, where steam power has been introduced, does not prevent the rails from being very seriously worn; the wheels skid along the grooves, and gouge the steel out in shreds of a foot in length. In reference to the weight of the car, it is quite true that you must have considerable weight on the steam-engine to work it up steep gradients, for without this weight the engine has not its proper power of adhesion. You can get no more out of an engine than its power of adhesion. When we are travelling through London, we are very often told by shopkeepers and others whose business premises abut on streets paved with wood, that their health is much improved owing to the diminution of sound. There is no doubt that wooden pavement is a great boon, and that it tends to the improvement of health; for, quite recently a proposed iron railway viaduct for the London and North-Western Railway Company, was thwarted in Parliament this Session on account of the alleged noise of the engines passing over it, and which was said would be detrimental to health. You will notice in Manchester that the iron girder rail system causes much noise where the cars pass along the rails. If Soutar's (Hopkins's) system was introduced, you would have the sound almost deadened, but of course wear and tear is a serious matter. Although some are enthusiastic in the introduction of steam, I am of opinion that if we consider the matter of less sound deadened by wood and the wear and tear of horseflesh, vehicles, and the safety of passengers, we would decide in favour of horses, in the question of steam *v.* horse-power.

Mr. White: Most of us will agree that to have certain places at which, and at which only, the tramcars may stop, would interfere so seriously with the receipts, that such a thing is almost out of the question. To be able to get in and out at any point on the line is the very thing that tempts people to spend a penny or twopence for a tram ride. There is one point, however, which I consider tells in favour of having fixed stopping places in towns where the system is worked by horses, which is that the stoppage of cars on steep gradients is thereby mostly avoided. It is a great strain upon the horses to start a car on an incline. It would be well, where inclines occur, if certain points were fixed (by bye-laws,

or otherwise) between which cars should *not* be allowed to stop. I make that suggestion in the interests of humanity, for it is painful to anyone who habitually rides, to see the tortures the poor horses are subject to.

Mr. Hewson: I find that generally steam is being gradually developed to the exclusion of horse traction. Now that we have the Government approval to the principle of steam at Leeds, I think this power should be introduced on all the roads. We have several steam routes already, and we are to-day at Leeds strengthening, with this view, other roads to meet the requirements of the Board of Trade before beginning to run other routes. With regard to the principal streets, Mr. Fowler mentioned Market Street, in Manchester, as an instance of a thickly populated thoroughfare, where it would not be safe to run steam-engines. Well, a similar street in Leeds is worked by steam. In Leeds the steam tramcars run the whole length of their routes.

Mr. Hall (Stockton): Now, as you are anxious that we should be down at the Fish Quay at 11 o'clock, I will not go through the various arguments that have been adduced by Mr. Pritchard, Mr. Vawser, and others, I will just go through one or two of the principal ones. As to the question of cost, I can assure you, gentlemen, that the figures that I have given are the actual cost of the working expenses of the tramway. I do not know that there is anything allowed for depreciation; the figures include such renewals as may fairly and reasonably be put down under the head of ordinary repairs. The tramway company in Stockton keep a staff of fitters and a manager to look after the repairs of the engines. They have always one engine in hand, so that each one can be overhauled when necessary. You will see if you look through this table that there is a great difference in the following items: on 1st January, 1883, 16*l.* 19*s.* 10*d.* is under the head of repairs and renewals, whereas on the 11th March, the cost was only 17*s.* 10*d.* There was material obtained for the use of shops' stores, which is included in the January account. Mr. Pritchard wanted to know the pressure of steam used on the tramways. I should not like to say positively what this pressure is. As I stated in my paper, the gradients in Stockton are of a suitable character for trams. We have only one short gradient of 1 in 18, for a distance of three chains. This is the only steep gradient of any importance. I did not lay myself open to discuss the con-

struction of tramcars, nor yet tramrails, but I might say that with reference to cars we are now trying a two-decker, with a suitable cover, with eight bogey wheels, and it answers most satisfactorily. When the mile and a half more of the tramlines is opened out, it is proposed by the company to increase the number of those cars. My experience of the regulating governor has been very similar to the other speakers. Really they are a delusion and a snare, as far as they have been used up to the present time. It is of great importance to have some one to look after them, to see that they are always in working order. It has been said that I was rather down upon Newcastle: well, I meant to be down on Newcastle for not having adopted steam. When I consider a place like Newcastle (my native town), where the people justly pride themselves upon their mechanical skill and inventive genius, I cannot for the life of me see why steam power should not be adopted. I fail to see why a steam-engine should take a better road than what there should be for horse traffic. I think we cannot be wrong in making the permanent way sufficiently strong to suit any class of traffic. Mr. Spencer said the smell of the oil from steam trams was very disagreeable. I am sorry Mr. Spencer is not here. I think it is a very far-fetched argument. There is a certain amount of smell from steam-engines, and so there is a certain amount of smell from horses. Touching the question of stopping places, I was not aware that they had been adopted in Liverpool and other towns, and also on the Continent. I think it is a very proper thing. The lessees are certainly in favour of having these stopping places. One thing that is very annoying, and a great nuisance to the general public who use tramways, is that people will insist upon being put down exactly at the place they want to get out at, and won't go six yards farther. I am sure that anyone that notices the great difficulty the horses have in starting a car on a steep gradient, will see the advisability of preventing it. Mr. White's suggestion would meet the case very well indeed. Some people say that it is very tantalising to see the tram pass your door, and not to be able to get in, but to have to go to the nearest stopping place. It is no more aggravating than in the case of a railway, where the train goes rushing past your house. As to Mr. Vawser's remarks about statistics, I have seen for myself the tramway company's books, and I can vouch for the accuracy of the figures, and can say that

there is not the slightest colouring in the table I have presented to you. It is not my desire to compare the various types of engines, only having had the advantage of thoroughly testing those of Messrs. Merryweather.

A vote of thanks was then accorded to Mr. Hall for his paper on "Steam Tramways."

THE COST OF LOCAL GOVERNMENT AND THE DISTRIBUTION OF THE FUNDS.

By F. S. BRUNTON, Assoc. M. Inst. C.E., Richmond.

In approaching the subject of the expenditure of local authorities, I feel that I am touching on very delicate ground. The Members of this Association may feel that in dealing with finance I am travelling somewhat beyond the scope of engineering; when it is reflected, however, what an overpowering influence the question of finance has on the prospects of the profession, it will not be necessary to apologise for asking you to give the matter your consideration.

It is hardly realised by the public generally, or by many surveyors, that the indebtedness of the nation in respect of money borrowed by local authorities has reached (up to the end of the financial year 1882–3) the enormous total of 151,704,640*l.*, being an increase during the last five years of over 45,000,000*l.* These are very respectable figures, and while they are matter for congratulation in some respects, it behoves those who are responsible for the expenditure of public money to look well at the proportions which this vast debt is assuming, in order that wherever leaks are to be found they may be promptly stopped, that substantial benefit may be derived from the expenditure, and that if this result is not obtained, to see that at any rate the saddle shall be placed on the right horse, and the blame not put, as I fear is often the case, on the head of the town surveyor.

When, under the terror inspired by the ravages of cholera in 1847, the Act of 1848 for improving the sanitary condition of towns was first passed, it would have somewhat cooled the ardour of enthusiastic sanitarians had they been told that they had set rolling a ball which within their own lifetime would roll into a public debt of 150,000,000*l.* of money, such a prospective statement would in those days have been laughed out of hearing, and indeed for many years such a prospect seemed remote enough, for it is only during the last fifteen years, and under Acts of Parliament

passed within that time, that such enormous sums as we now hear of have been borrowed. The following figures will give an idea of the eagerness with which local authorities have rushed into debt:—

In the year	1872–3	local	indebtedness was	80,000,000*l.*
„	1873–4	„	„	85,500,000*l.*
„	1874–5	„	„	92,820,000*l.*
„	1875–6	„	„	99,654,218*l.*
„	1876–7	„	„	106,302,385*l.*

While since it has been augmented as above stated to 151,704,640*l.*, of which sum about half has been spent by various urban sanitary bodies, and the other half by poor-law boards, school boards, &c. Nor is this all, for not only have the outstanding loans been increased to this extent, but the amount of rates levied in England and Wales has grown from 23,366,209*l.* in 1877, to 27,959,953*l.* in 1882.

However laudable the object with which this expenditure has been incurred, and however much good may have been done to the health and morals of the country by it, it is well known to all who are concerned in town management that enormous sums have been and are now being utterly wasted. I need hardly refer, in an assembly constituted as this is, to the millions of money spent in constructing works to pour filth into the rivers, and to the millions more which are now being spent to take it out again, or to the absurdly costly arbitrations over improvement schemes in which the little bills of lawyers and engineers figure so conspicuously, in verification of this remark.

Besides the flagrant instances of folly which you will have no difficulty in calling to mind in this category, there are several other ways in which reckless expenditure is encouraged. One is the practice of allowing money to be borrowed in large amounts for excessively long periods, I find from the Local Government Board Report, that Huddersfield and Kingston-upon-Hull figure as having borrowed for *one hundred years* the amounts of 50,000*l.* and 100,000*l.* respectively. That the Padiham Local Board has borrowing powers for an "unascertained amount" to be repaid in no less a term than eighty years, Rotherham and Halifax have got sixty years to repay loans of money used in the construction of gasworks. The borough of Birmingham, according to Mr. Chamberlain, had in 1877 utilised its unascertained borrowing powers to the tune of 5,000,000*l.*

Suppose in the ordinary way of business a private person was to

request a loan, on any security whatever, for the term of one hundred years, or in view of the development of the electric light was to express a desire to mortgage his gasworks for a large sum for sixty years, what success would he be likely to meet with? It is easy to assume that public bodies are under different circumstances from private persons, but the great difference upon which so much debt is piled, is by no means on so secure a foundation as would appear. Towns, like individuals, are subject to great fluctuations. In the case of places depending chiefly, even sometimes solely, on one branch of business—a large factory, or a route for traffic—I fail to see what solid security there is for large loans over long periods. I remember visiting a mushroom village a few years ago, and finding the houses absolutely empty and the streets grown over with grass, "the works" having been closed for some time! Where, in a case of this sort, is the money to come from to pay the annual charges? Suppose a seam of coal which is the sole support of a colliery district is worked out, or the case of transference of traffic from a town by reason of some railway alteration. In some cases where large sums have been lost, as in the case of the Thames Tunnel, the Government have wiped off the loan, but that is a very unjust arrangement for the taxpayer, and local authorities have no right to incur large debts with a vague prospect of their having to be paid by the nation at large. This is by no means an unlikely result. Take the case of a town overburdened with rates which are chiefly paid away towards the repayment of loans borrowed sixty years before, and suppose, as will most probably be the case, that new works of sewage disposal on improved principles are required by a new Act of Parliament, or possibly that the electric light has by that time superseded gas. The money must be forthcoming to meet the exigencies of the time. What will then be the probable action of such a town? why to appeal to the Local Government Board in terms something like as follows, viz.:—

Sixty years ago our ancestors were encouraged by Government, if not commanded, to lay out a large sum of money in sewering our district, and by facilities offered them for the purpose they contracted a loan which they engaged to pay off in one hundred years. The sewage of the district was then most satisfactorily removed from the houses to the river. Twenty years later your Government passed a new Act, which required us to reorganise our whole sewage arrangements in order to take the sewage out of the river. Now it having been discovered that a pestilence is likely to arise by

reason of our sewage works, that their construction has been all along on wrong principles, you very properly order us to re-sewer again on another method. The same line of argument applies to our gasworks, which are obsolete but not paid for; our street paving, for which large sums have also many years ago been borrowed, is worn out. It has not it appears worn so well as might have been anticipated, but unfortunately we owe a lot of money for it. We are pressed on all sides for money for new works. Our people demand a park, and the popularity of the town will wane if we do not have it. Our dock accommodation is not suitable for the present trade. We highly approve of your new system and we are most dutiful subjects, but will you please tell us whether we are to raise our rates from 7*s.* in the £, which they now are, to 10*s.* in the £, which will be absolute ruin to us, or whether you will ask Government kindly to take pity on us and pay our old debts, and we will ever pray, &c., &c.

This sort of thing has been done before, and must inevitably be done again if these enormous loans, over excessively long periods of time, are not put a stop to. If that were all, however—if it was merely that improper charges were made against the pocket of the nation by a few insolvent localities—we might, although deploring the necessity for it, bear the nation's injustice with some equanimity, but unfortunately the shoe pinches already. When those of us who own three houses have to pay one away to support the local burdens of the other two, we naturally feel very acutely. So we unbosom our feelings in our local newspapers; we indulge in satire at the expense of the most prominent local official we can find; we catch the town surveyor tripping over a paving-stone and pour on his luckless head the wrath which has been called forth by the stupid extravagance of our ancestors, and possibly of ourselves. As he generally (to his credit be it said) has more sense than to reply, we have it all our own way and he bears the brunt of the blame.

Now the point which I want to put for the consideration of this meeting is as follows, viz. What can the town surveyor do, by association or otherwise, to remedy this vast financial evil? It is one which affects his position seriously, not by reason of being wrongfully blamed, that he gets accustomed to, but the works which he is called upon to perform, and which are his pride and pleasure, are liable to be crippled by want of funds, which will arise as soon as these heavy burdens begin to be felt by the people.

It is not so much the works of the average town surveyor which consume the money which is so extensively borrowed, but the heroic schemes of eminent engineers, and the legal battles to which they give rise. It is time that the voice of the surveyor should be heard on the subject, and I respectfully submit to this Association that *it* is the channel through which it should be heard.

It remains for consideration in what way the matter can be dealt with. It is easy for each surveyor to note within his own circle many instances of wasteful expenditure. It may be easy for him to produce a perfect plan to accomplish any object which may be desired at a moderate cost, but alas, the prejudices of local board members, the counter-influences which have to be met and appeased, the alterations which leading supporters may make, often halved in their effect by counter-suggestions adopted to mollify opponents, so trim and disfigure his plan, that by the time it is ready for execution it is only fit to take its place as another expensive abortion, and this without the fault being chargeable to anybody in particular. I need not dilate on this phase of the subject, more especially as I have not invented a means of inducing members of boards to act collectively with the same common-sense which they display individually, and will simply pass on to point out subjects which it appears to me lie very close to the root of the difficulty, and which by being ventilated will drive home to the minds of people some of the initial conditions necessary for good local government.

In the first place I would draw your attention to the complications surrounding the incidents of rating—the confusion of local areas and the number of authorities overlapping each other in such a manner that no ratepayer, unless he is an accountant and surveyor combined, can with anything like readiness ascertain how much he is paying and precisely for what. If he takes the trouble to investigate the matter, he is almost as far off as ever from exercising any control over his representatives, for between the Poor Law board, the urban or rural sanitary authority, the highway board, which may be neither, and the school board, which may or may not comprise both, to say nothing of the bewilderment arising from the distinction between the county and borough magistrates, even where there are no unions of districts for special purposes, such as drainage or river conservancy, his representatives are so numerous and so variable that he can do nothing in the way of bringing influence to bear upon them all.

This is the case all over the country to some extent. In London the confusion is worse confounded, I do not believe that any human being does know exactly what is the province of each of the many guilds, vestries, boards of works, commissioners of sewers, &c.—if there is such a person he should be secured as a public guide.

The ignorance arising from the complication of areas is one of the chief causes why so little action is taken by the public; if they did take more active interest in the various questions they would understand them better, and many a wretched blunder born of cliqueism and prejudice would be prevented from passing into a public debt. This is a kind of ignorance which an Association of Surveyors might do something to dispel, and is one way towards an improvement.

Another way would be to discuss and diffuse information as to the localities where public works are proposed to be subsidised out of the rates, such as in the case of the Irish Tramways Act, which empowers the grand jury of the county to guarantee the interest of the capital spent in making tramways throughout Ireland. Though this may be a highly desirable thing to do in many districts, there are many desolate tracts of land which will never recoup the promoters of such lines, and great care and attention should be bestowed by the public to see that grants are not made in places where the works are useless and would be a heavy drag on the already overburdened neighbourhood.

I need not suggest to the Members of this Association the many ways in which improvements might be effected in the money spending department, they will occur to you more readily than I should be able to suggest them; but I trust that I have stated enough to show that the subject is one which concerns the surveyor so much, that in his own interest and in the interest of his employers the public, he should deal actively with it, and take such measures as will bring it as far as possible under his control.

On the afternoon of the first day the Members visited various objects of interest in the town—The Old Castle; the American Steam Laundry, New Bridge Street; the Armstrong Park; and Messrs. R. and W. Hawthorn's Locomotive Works; and in the evening dined together at the Turk's Head Hotel, Newcastle.

On the second day the Members paid a visit to the Ordnance and Engine Works of Sir Wm. Armstrong, Mitchell, and Co., at Elswick. A visit was also paid to the factory of the Swan and

Edison Electric Light Company at Benwell, where the Members were very courteously chaperoned over the works, by Mr. Gimingham. The Elswick Colliery was open for inspection, where, however, but few availed themselves of the privilege offered of going down the pit.

On the third day the Members embarked on board the 'J. C. Stevenson,' lent by the Tyne Commissioners. Mr. Messent, jun., accompanied the party, and very kindly gave every information. The swing bridge was opened that the Members might see the working of the hydraulic machinery by which the operation is effected. Proceeding down the river, visits were then paid to the Corporation cattle lairs lately constructed, to Potter's Cement Works, and to the Coble Dene Docks. The party then continued their journey, and were landed at the North Pier in Tynemouth Haven. An opportunity was there afforded them of witnessing the rocket drill of the Tynemouth Volunteer Life Brigade, Alderman Spence explaining the working of the rocket apparatus to the Members, who witnessed a line sent from the banks near the Spanish Battery over the North Pier, two lads being afterwards hauled across the Haven in "the breeches."

Memoirs of Deceased Members.

The Council, having been requested to append some short notice of the decease of Members of this Association, will feel obliged by early notice being forwarded to the Secretary, with such particulars as it may be desirable to insert in these 'Proceedings.'

It is with much regret that the Council have to chronicle the deaths of the following gentlemen, Members of this Association:—Mr. Jeffery Austin Hall died at Toxteth Park, Liverpool, on the 14th April, 1884. Mr. Hall was born in 1826, and was first employed on the Staff of the Ordnance Survey in different parts of Ireland. He was then transferred to Yorkshire, where he continued to fill his position with great credit to himself. After leaving the Ordnance Survey, he was employed to supervise the work of surveying and levelling of Bradford. He then undertook the plans, &c., of Willenhall, and was soon afterwards appointed to the town surveyorship of Willenhall, a post he retained for seven years and which he surrendered to take the surveyorship of the Toxteth Park Local Board of Health in 1861, which position he held till the time of his death. In Toxteth Park, Mr. Hall succeeded in effecting vast improvements in sanitary and other work, the death-rate having diminished to about 10 per 1000, Toxteth Park (Rural) being thus now one of the healthiest districts in the kingdom, the population since 1861 having more than doubled, and the rateable value quadrupled.

The remaining deaths are Mr. R. Salisbury of Burnham, Somerset, who died in January 1883; and Mr. J. Holmes, of Selby, Yorkshire.

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PREPARED BY S. S. PLATT, ASSOC. M. INST. C.E.;

BOROUGH SURVEYOR, ROCHDALE.

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THIS Index is presented to the Members of the ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS with the hope that it will enhance the value of the 'Proceedings' as a work of reference.

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